

SECTION 7C

TRANSMISSION

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SERVICE /SPECIAL TOOLS

1. SERVICE /SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Directional clutch shaft (input shaft) pusher /pulling bolt	M12
Directional clutch shaft (input shaft) pusher /pulling bolt washer	M12
Directional clutch shaft (input shaft) eyebolt	M12
Range clutch shaft (output shaft) pusher /pulling bolt	M12
Range clutch shaft (output shaft) pusher /pulling bolt washer	M12
Range clutch shaft (output shaft) eyebolt	M12
Countershaft pusher /pulling bolt	M12
Countershaft pusher /pulling bolt washer	M12
Countershaft eyebolt	M12
Ball bearing	.5/8"
Directional clutch shaft (input shaft) bridge assembly	21.559.0031
Range clutch shaft (output shaft) bridge assembly	21.559.0032
Transmission assembly rotational stand	21.851.0029
Directional clutch shaft piston spring compressing tool	21.552.0015
Range clutch shaft piston spring compressing tool	21.552.0016
Charge and cooler pump insertion tool (C dim.)	9104-M-328-1
Charge and cooler pump insertion tool (D dim.)	9104-M-329-1

TRANSMISSION

GENERAL

2. DESCRIPTION

The transmission is designed to provide gears shifting by using hydraulic actuated clutches. It has three forward and three reverse speeds. The transmission is bolted to the front of the rear part main frame, and is coupled to the torque converter by a drive shaft with a universal joint on each end. The drive shaft rotates the transmission input shaft. The transmission also contains an output shaft, a counter shaft and a reverse idler shaft.

Directional Clutch Shaft (Input Shaft)

The directional (input) shaft rotates on two tapered roller bearings. The shaft consists of forward and reverse drive gears, which ride on caged roller bearing. It also contains, the dual hydraulic clutch pack assembly for forward and reverse drive gears.

Countershaft

The countershaft rotates on two tapered roller bearings. The shaft consists of third drive gear, second drive gear and first drive gear. The second drive gear is splined to the rear of the shaft and held in place by retaining rings. It is in constant mesh with the reverse idler gear and the second speed driven gear. The third drive gear is splined to the center of the shaft and held in place by retaining rings. It is in constant mesh with the forward drive gear and the third speed driven gear. The first speed drive gear is splined to the front of the shaft and held in place by retaining rings. It is in constant mesh with the first speed driven gear.

Reverse Idler Shaft

The reverse idler shaft is bolted to the transmission cover in a fixed position. The shaft consists of a reverse idler gear which rides on two tapered roller bearings and is in constant mesh with the reverse drive gear and the second drive gear.

Range Clutch Shaft (Output Shaft)

The range (output) shaft rotates on two tapered roller bearings. The shaft consists of first, second and third speed driven gears which ride on caged roller bearings. It also contains the single hydraulic clutch pack assembly for the first speed driven gear and the dual hydraulic clutch pack assembly for the second and third speed driven gears.

Pressure Regulator Valve

The pressure regulator valve (5, Fig. 7C.1) contains three spools. The main spool limits the pressure at output side of the charge pump to 1790 - 1930 [kPa]. The oil at this pressure is used for clutch pack engagement. Excess oil from the main spool is channeled to the converter spool, then to the lubrication spool.

The converter spool limits the pressure in the torque converter inlet to 550 - 690 [kPa]. Oil leaving the converter is directed to the oil cooler. From the cooler, the oil is directed to the transmission output shaft manifold, when it meets with the oil coming from the lubrication spool. This oil and the excess oil dumped by the converter spool is used to lubricate the transmission. The lube oil pressure is limited to 350 - 450 [kPa]. Excess lube oil is dumped into the transmission sump. It should be noted that lube pressure will be lower in gear than it is in neutral.

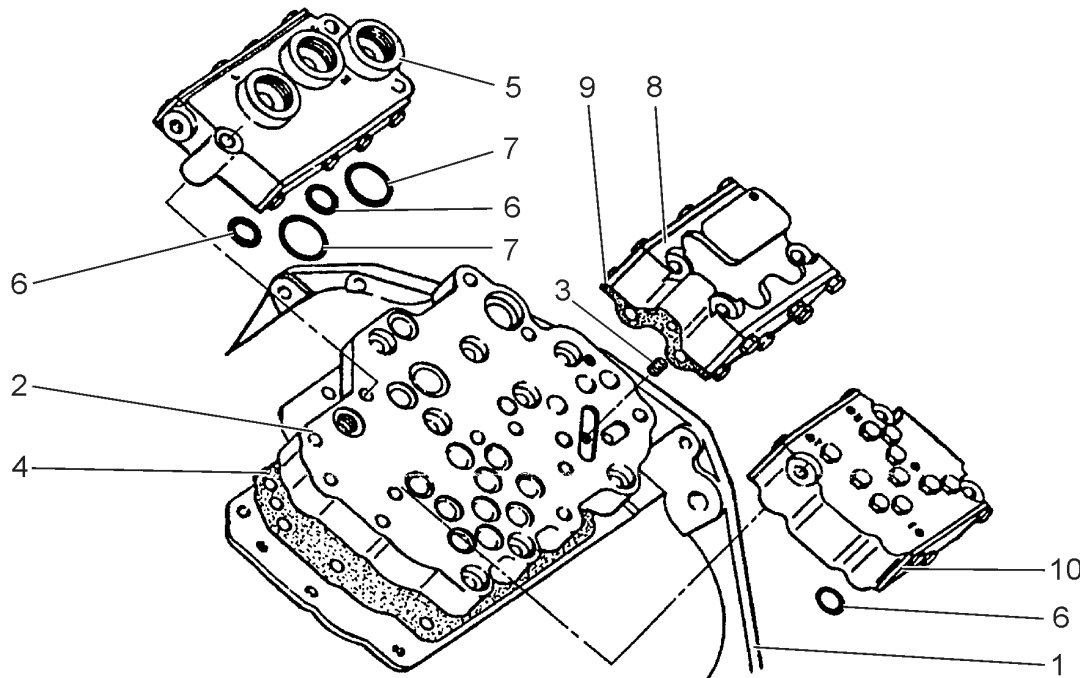
GENERAL

Fig. 7C.1. Transmission and Valves Location

- | | |
|-----------------------------|------------------------------|
| 1. Transmission Assy | 6. O-Ring |
| 2. Transmission Manifold | 7. O-Ring |
| 3. Orifice Strainer | 8. Rate of Rise Valve |
| 4. Manifold Gasket | 9. Rate of Rise Valve Gasket |
| 5. Pressure Regulator Valve | 10. Range Selector Valve |

Range Selector Valve

This valve (10, Fig. 7C.1) consists of one switch spool, one directional selector spool and two range selector spools which are hydraulically controlled. In "forward", oil pressure is exerted between the two directional selector spools, causing the short switch spool to compress the spring and the long directional spool to remain in place. In "reverse", oil pressure is exerted on the end of the long directional selector spool, causing both spools to move against the spring. In "first or second" (transmission gears), oil pressure is applied against one of the range selector spools causing it to compress the spring. In "third", no oil pressure is applied and the range selector spools are held in place by the spring. When the spools are shifted, oil pressure from the rate of rise valve (3) enters the range selector valve and exits through openings not covered by the spool and on to the transmission to engage the two clutch packs: one directional and one range clutch pack.

Rate of Rise Valve

Rate of rise valve (8, Fig. 7C.1) sequences the flow and regulates the pressure of the oil to the directional and range clutch packs during shifting. When a shift occurs, oil from the range selector valve (10) enters the rate of rise valve and is first directed to the directional clutch pack. When this clutch pack is full, the pressure rises and opens the sequence spool to allow the range clutch packs to fill while the pressure to the directional clutch pack remains the same. When the range clutch pack is full, the pressure in all the packs begins to raise evenly. Because the pressure in the directional clutch pack is greater, it fully engage before the range clutch pack, allowing any slippage to occur only in the latter. This delayed engagement time is created by modulating piston and allows a smooth shift without shock.

TRANSMISSION

GENERAL

3. SPECIFICATIONS

Transmission

Type	Power Shift
Number of forward speed	3
Number of reverse speed	3

Directional Clutch Shaft (Input Shaft)

Shaft end play	0.13 - 0.25 [mm]
----------------------	------------------

Reverse clutch pack

Number of friction discs (internally splined clutch plates)	16
Number of separator plates (externally splined clutch plates)	15
Thickness of friction disc	2.82 - 2.98 [mm]
Thickness of separator plate	2.25 - 2.35 [mm]

Forward clutch pack:

Number of friction discs (internally splined clutch plates)	14
Number of separator plates (externally splined clutch plates)	13
Thickness of friction disc	2.82 - 2.98 [mm]
Thickness of separator plate	2.25 - 2.35 [mm]
Friction disc and separator plate must be flat within	0.05 [mm]

Range Clutch Shaft (Output Shaft)

Shaft end play	0.13 - 0.25 [mm]
----------------------	------------------

First speed clutch pack:

Number of friction discs (internally splined clutch plates)	17
Number of separator plates (externally splined clutch plates)	16
Thickness of friction disc	2.82 - 2.98 [mm]
Thickness of separator plate	2.25 - 2.35 [mm]

Second speed clutch pack:

Number of friction discs (internally splined clutch plates)	16
Number of separator plates (externally splined clutch plates)	15
Thickness of friction disc	2.82 - 2.98 [mm]
Thickness of separator plate	2.25 - 2.35 [mm]

Third speed clutch pack:

Number of friction discs (internally splined clutch plates)	15
Number of separator plates (externally splined clutch plates)	14
Thickness of friction disc	2.82 - 2.98 [mm]
Thickness of separator plate	2.25 - 2.35 [mm]

Countershaft

Countershaft end play 0.13 - 0.25 [mm]

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TRANSMISSION**GENERAL****Special Bolt and Nut Torque Data**

Universal joint mounting bolts	270 ± 7% [Nm]
Transmission mounting bolts	760 [Nm]
Reverse idler shaft mounting bolt	385 ± 10% [Nm]
Baffle to cover mounting bolts	106 ± 10% [Nm]
Baffle to housing mounting bolts	80 ± 10% [Nm]
Housing to cover mounting bolts	80 ± 10% [Nm]
Rate of rise valve end cover bolts	26 - 28 [Nm]
Range selector valve end cover bolts	26 - 28 [Nm]
Pressure regulator valve end cover bolts	26 - 28 [Nm]
Input and output shaft manifold bearing bolts	80 ± 10% [Nm]
Countershaft cap bolts	80 ± 10% [Nm]
Directional shaft pusher / pulling bolt	108 [Nm]
Range clutch shaft pusher / pulling bolt	217 [Nm]
Countershaft pusher / pulling bolt	108 [Nm]

NOTE: Except for the special torques shown, all bolts and nuts are to be given a standard torque. Refer to SECTION 1.

Springs

Spring	Free Length [mm]	Test Length [mm]	Test Load [N]	Total Number of Coils
Pressure Regulator Valve:				
Torque Converter Spool Spring	64.8	50.8	169 - 196	11.3
Lube Spool Spring	81.6	50.8	96 - 109	19
Main Spool Ball Spring	21.1	15.4	75 - 83	9
Main Spool Inner Spring	49.8	35.0	193 - 207	12.5
Main Spool Outer Spring	76.5	52.5	380 - 398	13.5
Rate of Rise Valve:				
Piston Spring (Inner)	88.0	71.1	160 - 178	17.5
Piston Spring (Outer)	46.3	31.7	160 - 178	6
Reducing Spring	45.0	19	245 - 262	5.5
Sequence Spool Spring	89.7	25.4	69 - 73.5	8.6
Range Selector Valve:				
Directional Selector Spool Spring	48.7	35.5	249	13
Range Selector Spool Spring	48.7	35.5	249	13
Transmission:				

TRANSMISSION

Range Clutch Pack Springs	97.9	62	277	15
Directional Clutch Pack Springs	58.2	42	245	10

TRANSMISSION

TRANSMISSION

4. REMOVAL

NOTE: It is required that Paragraph 8, TROUBLE SHOOTING in SECTION 7 be reviewed and the pressure checks in Paragraph 10, TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST be taken before removing the transmission. In this manner, hydraulic malfunctions can be pinpointed and corrected at time of teardown.

NOTE: In case of range shaft seal rings and/or manifold failure it is possible to replace damaged parts without removing the transmission. For replacement of damaged parts first remove transmission case guard from bottom of machine. Replace respective seal rings and/or manifold. Refer to relative Paragraphs in this Section.

NOTE: It is possible to remove the transmission without removing the range selector valve and pressure regulator valve. In this case tag the hoses of drive train control valve, diagnostic center, steering valve and gear shifting valve, and disconnect these hoses from pressure regulator valve and range selector valve.



WARNING! Before working on a machine, be sure that the blade and ripper have been lowered to the ground, the engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and controls are tagged to prevent inadvertent engine starting.

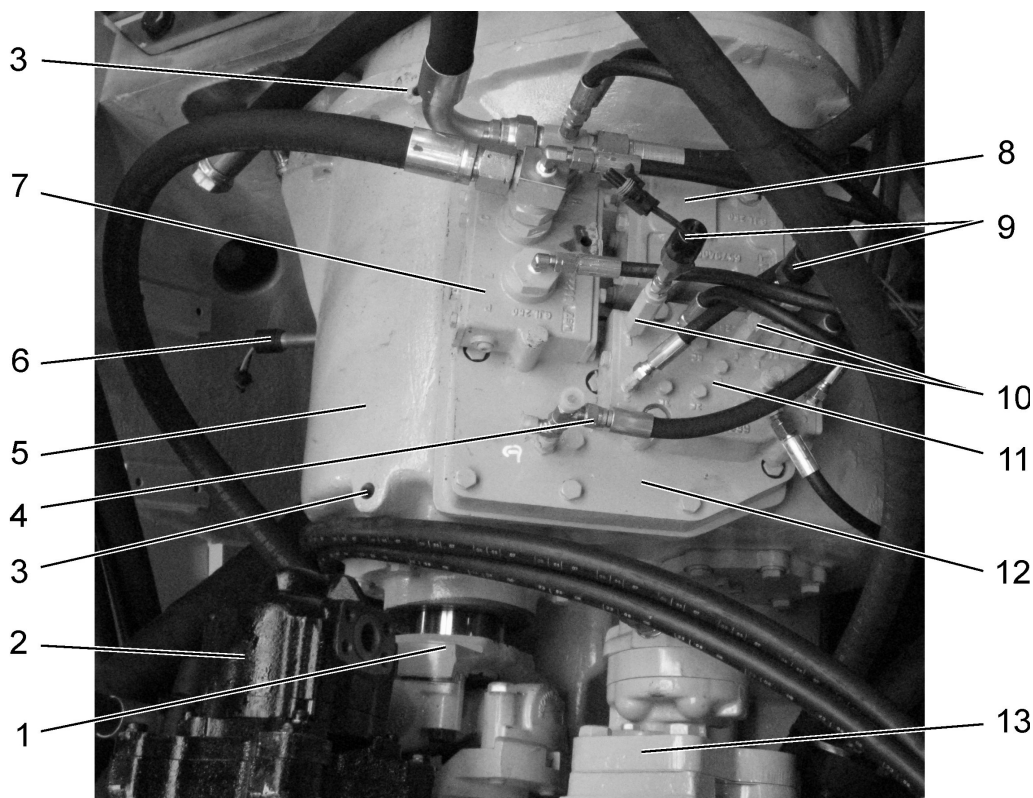


Fig. 7C.2. Transmission Disconnecting Points (Top View)

- | | | |
|--------------------|---------------------------------|-----------------------------|
| 1. Universal Joint | 6. Trans Input Shaft RPM Sensor | 11. Range Selector Valve |
| 2. Equipment Pump | 7. Pressure Regulator Valve | 12. Valves Manifold |
| 3. Eyebolt Hole | 8. Rate of Rise Valve | 13. Pilot and Scavenge Pump |
| 4. Drain Hose | 9. Pressure Switches | |
| 5. Transmission | 10. Check with Orifice Valves | |

TRANSMISSION

IMPORTANT: When disconnecting hydraulic lines for any reason, they should be properly capped with the correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt or lint into critical hydraulic components of the machine. Tag all disconnected oil lines to facilitate easier installation.

1. Drain the main frame and hydraulic reservoir as described in the OPERATOR'S MANUAL.
2. Remove the transmission case guard from bottom of machine.



WARNING! This procedure requires extreme caution. Use suitable blocking equipment while under confines the machine.

3. Remove the ROPS, cab and platform. Refer to SECTION 13, SUPERSTRUCTURE.
4. Remove the equipment pump (2, Fig. 7C.2) from the torque converter. Refer to SECTION 10A for removing procedure.
5. Disconnect two outlet hoses from the charge and cooler pump (4, Fig. 7C.3) and shift them away.
6. Disconnect the electrical harness from the pressure switches (9, Fig. 7C.2) located on the range selector valve (11) and remove pressure switches (9). Remove check with orifice valves (10), if needed. Disconnect the electrical harness from input shaft RPM sensor (6) and remove the sensor (6), if necessary. If removed, use suitable plug to prevent dirt and dust from entering.
7. Disconnect drain hoses (4) from the valves manifold (12).
8. Disconnect supply hose from the pressure regulator valve (7). Disconnect torque converter supply hose from the pressure regulator valve (7).

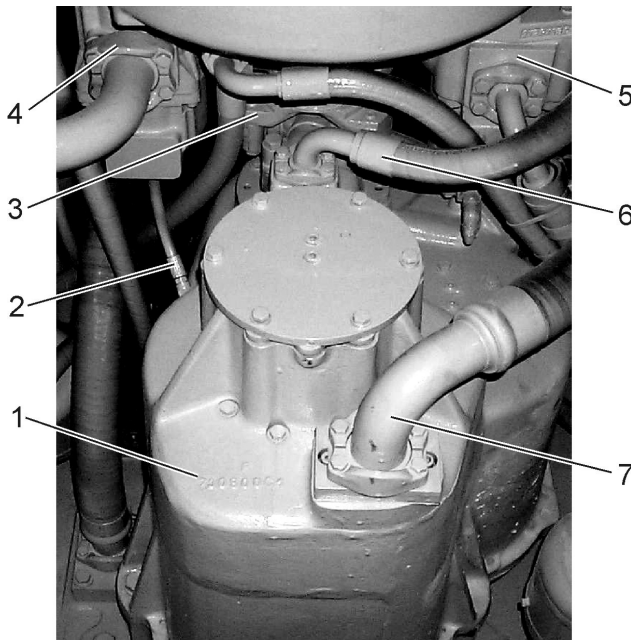


Fig. 7C.3. Transmission Disconnecting Points
(Bottom View)

- | | |
|---------------------------|----------------------------|
| 1. Transmission | 5. Scavenge and Pilot Pump |
| 2. Breather Hose | 6. Lube Hose |
| 3. Universal Joint | 7. Scavenge Suction Hose |
| 4. Charge and Cooler Pump | |

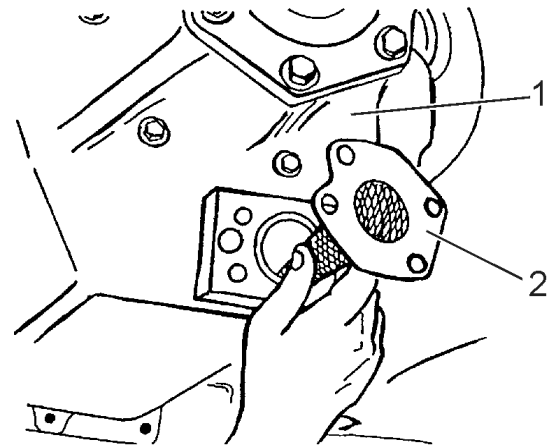


Fig. 7C.4. Scavenge Pump Strainer

- | |
|-----------------|
| 1. Transmission |
| 2. Strainer |

SECTION 7C

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TRANSMISSION

TRANSMISSION

9. Remove the hardware securing the range selector valve (11) and pressure regulator valve (7) to the manifold (12) located on top of the transmission (5). Tie the valves (with hoses still attached) up out of the way.

NOTE: *Wrap the valves with foil to be protected from dirt and dust.*

10. Disconnect the torque converter breather hose (2, Fig. 7C.3) from the transmission (1).
11. Disconnect the scavenge suction hose (7) from the transmission (1).
12. Remove the strainer (2, Fig. 7C.4) from the transmission (1).
13. Disconnect lube hose (6, Fig. 7C.3) from the transmission (1).
14. Remove the scavenge and pilot pump (5, Fig. 7C.3) from the torque converter. Refer to SECTION 10A, PUMPS for removing procedure.

NOTE: *Before removing the universal joint, wire or tape the bearing caps to prevent them from falling off the spider trunnions.*

15. Remove the universal joint (3) from between the torque converter and transmission:
 - a. Unscrew four bolts connecting the joint to the torque converter flange.
 - b. Unscrew four bolts connecting the joint to the transmission.
16. Install two lifting eyebolts M16 in threaded holes (3, Fig. 7C.2) provided in top of transmission. Attach a hoist and sling with a lift hook to two lifting eyes threaded into transmission body (5). Remove slack from hoist so that will support transmission when transmission mounting bolts are removed.

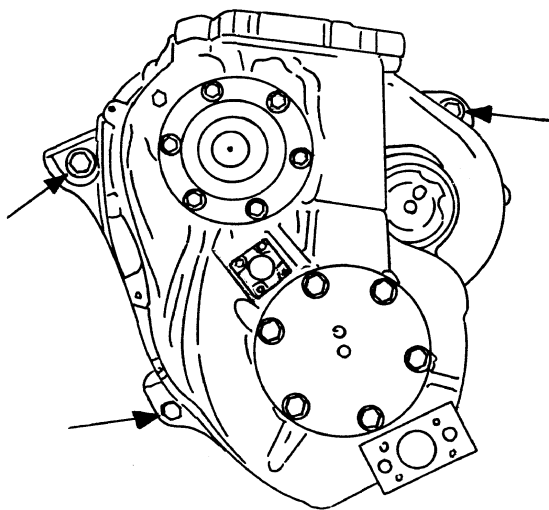


Fig. 7C.5. Bolts Securing Transmission to the Rear Main Frame

17. Remove three bolts securing transmission to main frame (Fig. 7C.5). Move transmission forward to free output shaft from steering drive. Lift the transmission up of the machine.

NOTE: *Cover the opening in the main frame to prevent dirt and dust from entering.*

18. Position the transmission assembly on a stand so that transmission cage is up as shown on Fig. 7C.8. If not previously removed, unscrew the hardware securing the range selector valve (11, Fig. 7C.2) and pressure regulator valve (7) to the manifold (12) located on top of the transmission (5). Remove the valves with hoses still attached. Discard O-rings. (6 and 7, Fig. 7C.1).
16. Remove yoke assy (39, Fig. 7C.7) from the directional input shaft (2).

TRANSMISSION

5. DISASSEMBLY

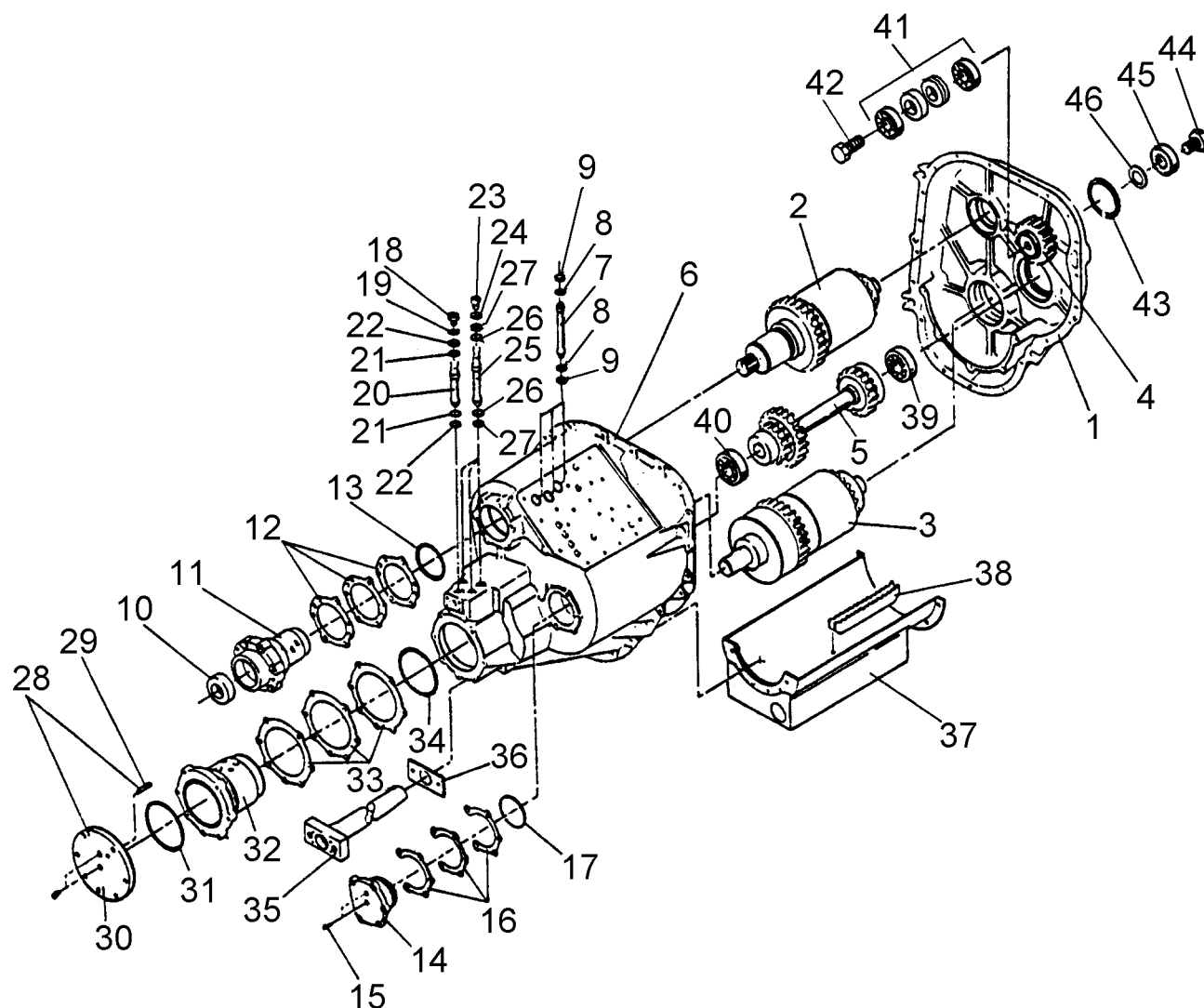


Fig. 7C.6. Exploded View of Transmission

- | | | |
|------------------------|-------------------------|--|
| 1. Rear Cover | 17. O-Ring | 33. Shim |
| 2. Directional Clutch | 18. Lube Tube Plug | 34. O-Ring |
| 3. Range Clutch | 19. O-Ring | 35. Scavenge Tube |
| 4. Reverse Idler Shaft | 20. Lube Transfer Tube | 36. Scavenge Tube Gasket |
| 5. Countershaft | 21. O-Ring | 37. Oil Baffle |
| 6. Housing Assy | 22. Seal Ring | 38. Magnet |
| 7. D.C. Transfer Tube | 23. Range Tube Plug | 39. Rear Tapered Roller Bearing |
| 8. O-Ring | 24. O-Ring | 40. Front Tapered Roller Bearing |
| 9. Seal Ring | 25. Range Transfer Tube | 41. Double Tapered Roller Bearing Assy |
| 10. Yoke Seal | 26. O-Ring | 42. Shaft |
| 11. Manifold | 27. Seal Ring | 43. Retaining Ring |
| 12. Shim | 28. Cover | 44. Bolt |
| 13. O-Ring | 29. Dowel Pin | 45. Plate |
| 14. Cup Retainer | 30. Plug | 46. O-Ring |
| 15. Plug | 31. O-Ring | |
| 16. Shims | 32. Manifold | |

TRANSMISSION

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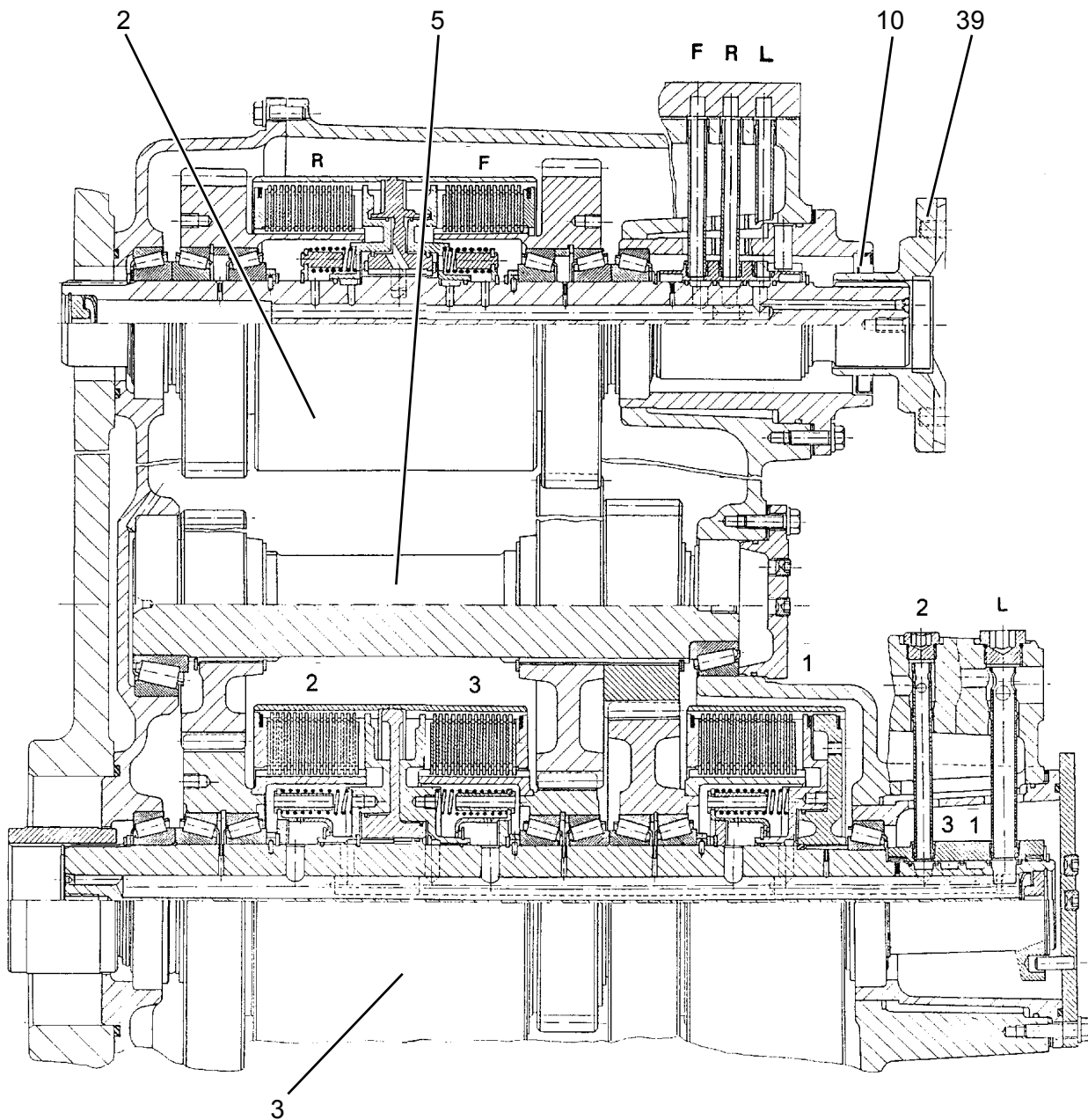


Fig. 7.C7. Cross Section View of Transmission

- 2. Directional Clutch Shaft (Input Shaft)
- 3. Range Clutch Shaft (Output Shaft)
- 5. Countershaft
- 10. Yoke Seal
- 39. Yoke Assy

TRANSMISSION

Transmission Housing and Cover (Refer to Fig. 7C.6)

NOTE: Unless otherwise notated, following step callouts refer to Fig. 7.C.6.

1. After removing transmission from machine, block transmission up so that input and output shafts are facing up (Fig. 7C.8).

Fig. 7.C.8. Positioning of Transmission

2. Remove yoke seal (10). Remove cover plate (28), O-ring (31) and dowel pin (29) from transmission housing (6). Remove retaining ring (Fig. 7C.9 and 1, Fig. 7C.33) and thrust race (Fig. 7C.10 and 2, Fig. 7C.33) from range clutch shaft.

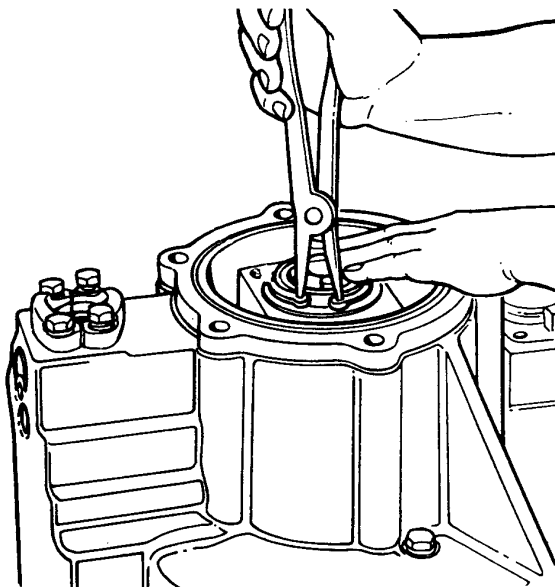


Fig. 7C.9. Retaining Ring Removal

Fig. 7C.10. Thrust Race

TRANSMISSION

TRANSMISSION

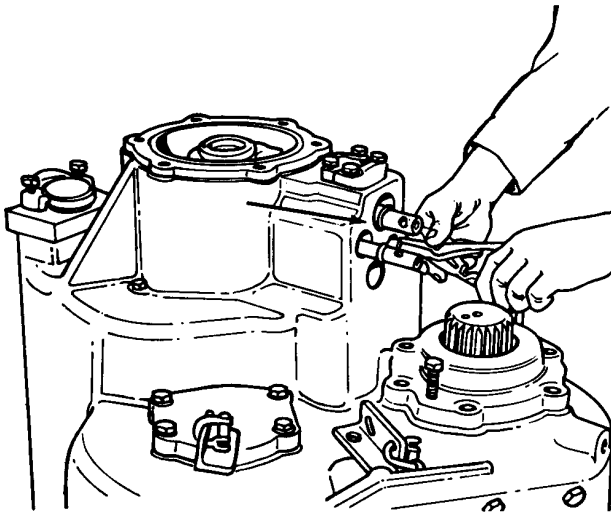


Fig. 7C.11. Oil Tubes Removal



Fig. 7C.12. Output Manifold Removal

3. Remove plugs (18 and 23) from housing (6). Remove lube and range oil transfer tubes (20 and 25) using snap ring pliers (Fig. 7C.11). Remove output shaft manifold (32) with bearings from range clutch (Fig. 7C.12).

4. Remove rate of rise valve (2, Fig. 7C.13). Remove gasket (3) from rate of rise valve. Remove bolts securing valve manifold (1) to transmission housing.

NOTE: Be sure to remove rate of rise valve gasket completely.

5. Remove the manifold (1, Fig. 7C.13) and manifold gasket (4) from the transmission (5).

NOTE: Remove bolt with orifice and screen filter from valve manifold channel.

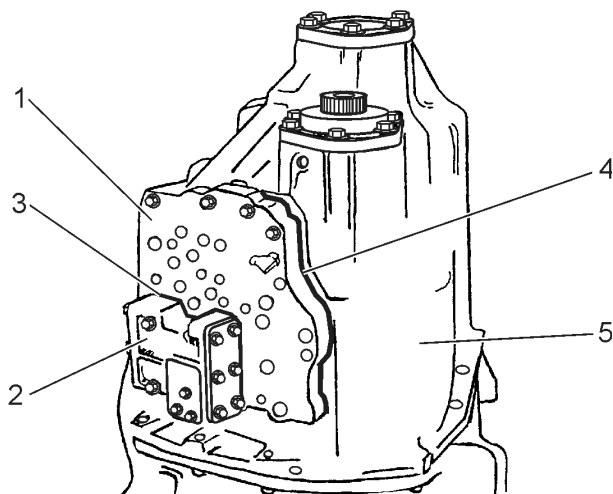


Fig. 7C.13. Removing Valve Manifold

- | | |
|------------------------------|--------------------|
| 1. Valve Manifold | 4. Manifold Gasket |
| 2. Rate of Rise Valve | 5. Transmission |
| 3. Rate of Rise Valve Gasket | |

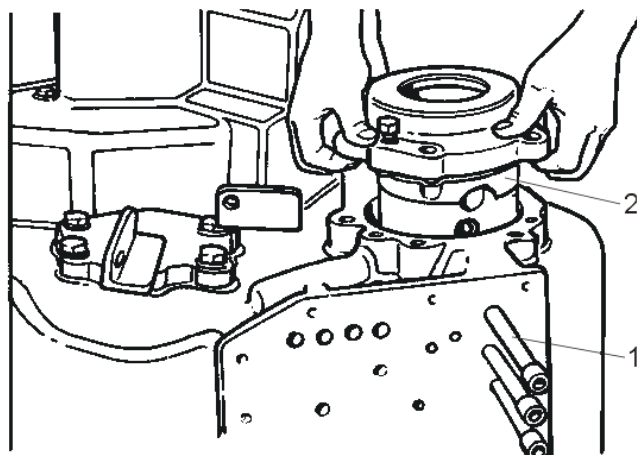


Fig. 7C.14. Directional (Input) Shaft Manifold and Tubes Removal

- | |
|-----------------------|
| 1. Oil Transfer Tubes |
| 2. Manifold |

TRANSMISSION

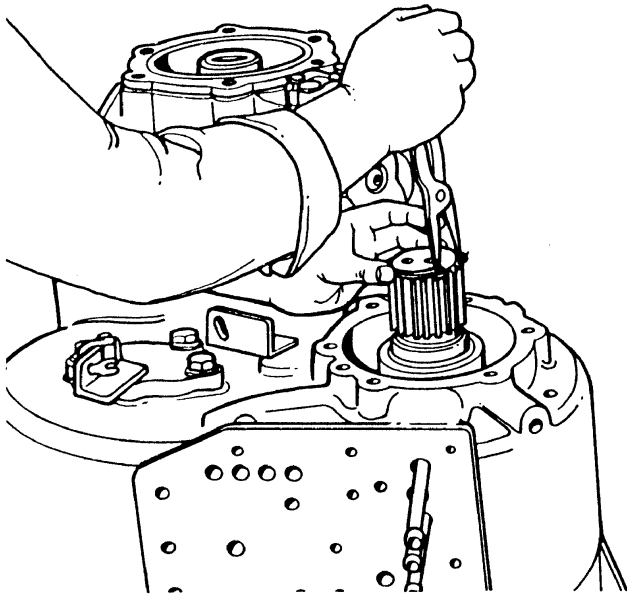


Fig. 7C.15. Directional (Input) Shaft Retaining Ring Removal

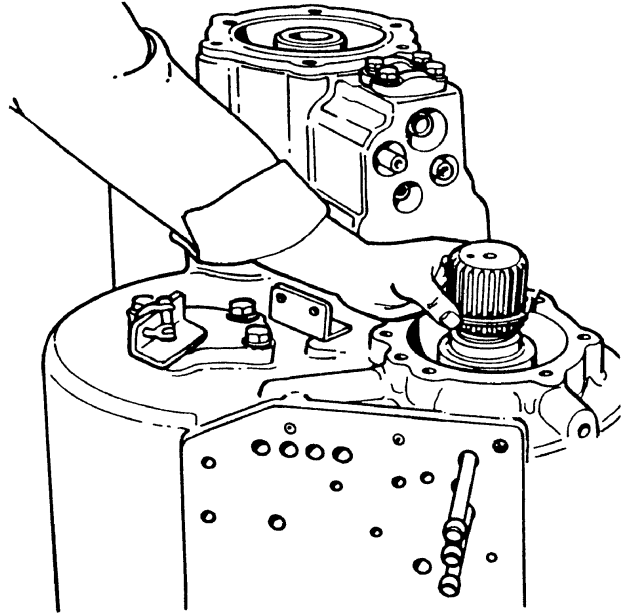


Fig. 7C.16. Thrust Race Removal

6. Remove directional shaft oil transfer tubes (1, Fig. 7C.14) before attempting to remove manifold (2). Remove manifold (2) by removing bolts and using jackscrew holes. Remove retaining ring (Fig. 7C.15 and 1, Fig. 7C.28) from directional (input) shaft. Remove roller thrust race (Fig. 7C.16 and 2, Fig. 7C.28).

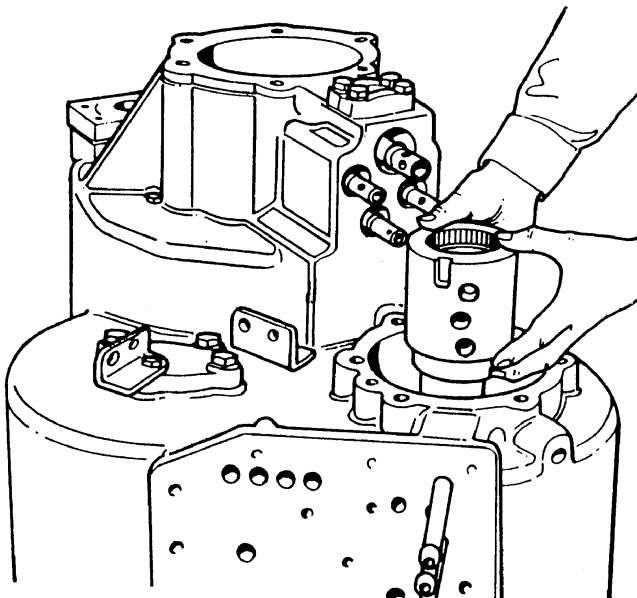


Fig. 7C.17. Manifold Removal

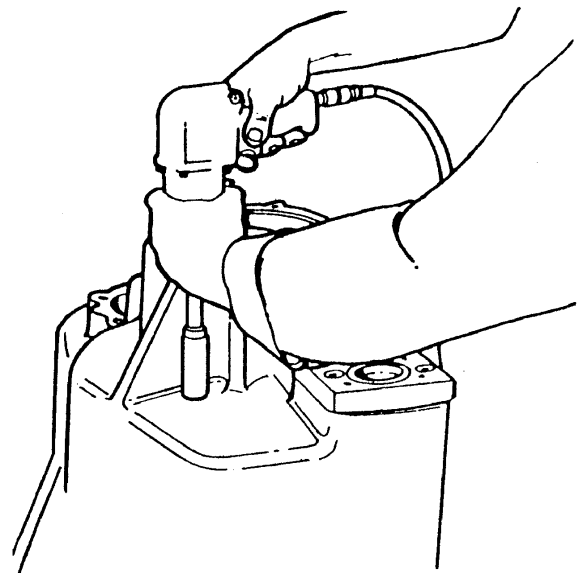


Fig. 7C.18. Oil Baffle Bolts Removal

7. Remove input shaft manifold (Fig. 7C.17 and 11, Fig. 7C.6) with bearings. Remove shims (12) from under manifold. Remove bolts securing rear cover (1) to housing (6) and bolts securing housing to oil baffle (37) (Fig. 7C.18). Remove scavenge tube (35) with gasket (36).

TRANSMISSION

TRANSMISSION

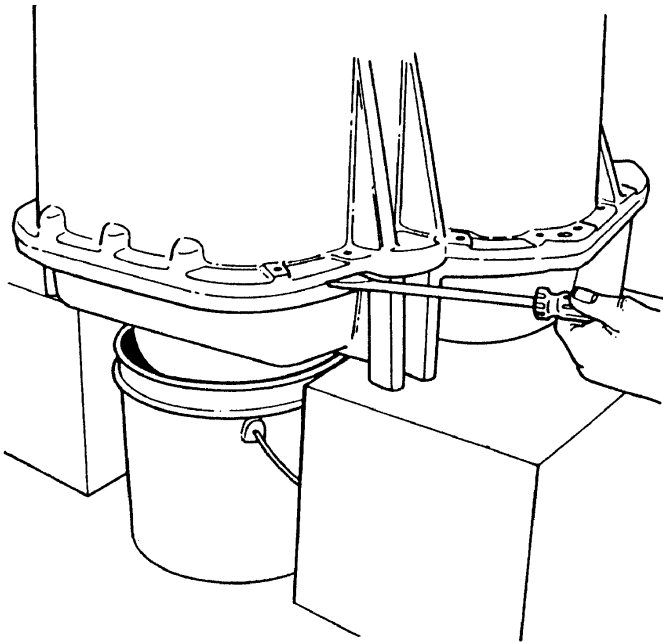


Fig. 7C.19. Prying Housing

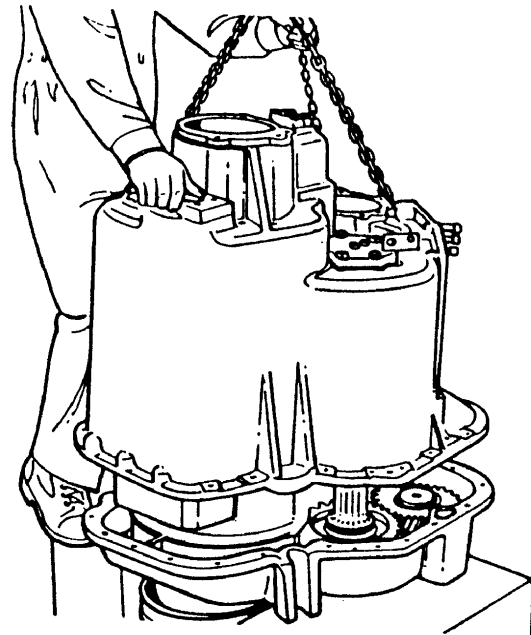


Fig. 7C.20. Lifting Housing

8. Drive dowel pins down to allow housing removal. Using slots provided, pry cover from housing (Fig. 7C.19). Attach lifting chains in three positions (Fig. 7C.20) and lift housing off cover.
9. Remove oil baffle (37) and magnet (38). Thread a M12 lifting eye into threaded hole in end of input directional shaft (2) and lift shaft out (Fig. 7C.21) of transmission cover. Thread a M12 lifting eye into thread hole in end of output shaft (3) and lift shaft out of transmission cover. Remove countershaft (5).

NOTE: Refer to each individual component assembly service procedures.

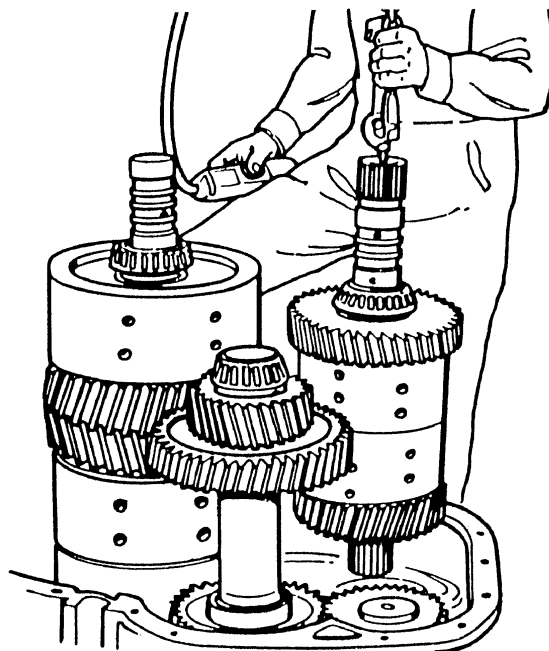


Fig. 7C.21. Directional Clutch Removal

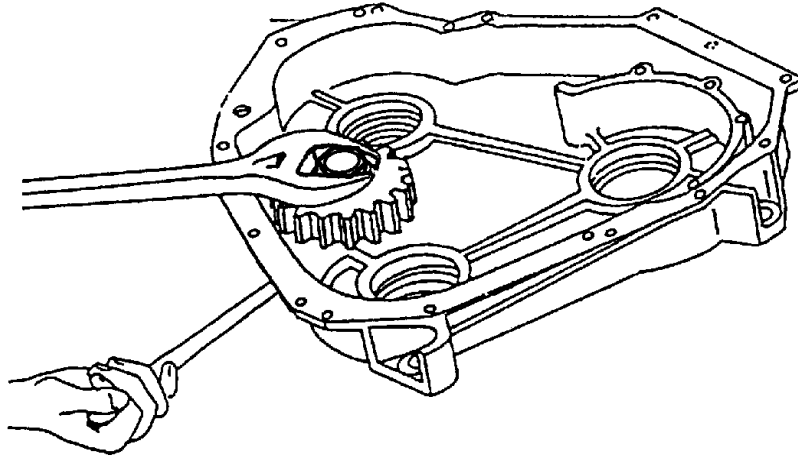
TRANSMISSION**Reverse Idler Gear (Refer to Fig. 7C.23)**

Fig. 7C.22. Removing Reverse Idler Shaft

10. Remove the bolt (1) securing plate (2) as shown in Fig. 7C.22. Remove plate (2) and O-ring (3). Tap the reverse idler gear shaft (8) from the cover (4).
11. Place the shaft assembly in a press so the shaft (8) points up and the gear (7) supports the assembly. Using a suitable driver, press the shaft out of the gear. One bearing cone of bearing assembly (5) will be pressed off with the gear (7).
12. Remove the cone spacer of bearing assembly (5) from shaft (8). If bearing or gear replacement is necessary remove the bearing cups from both ends of the gear (7).

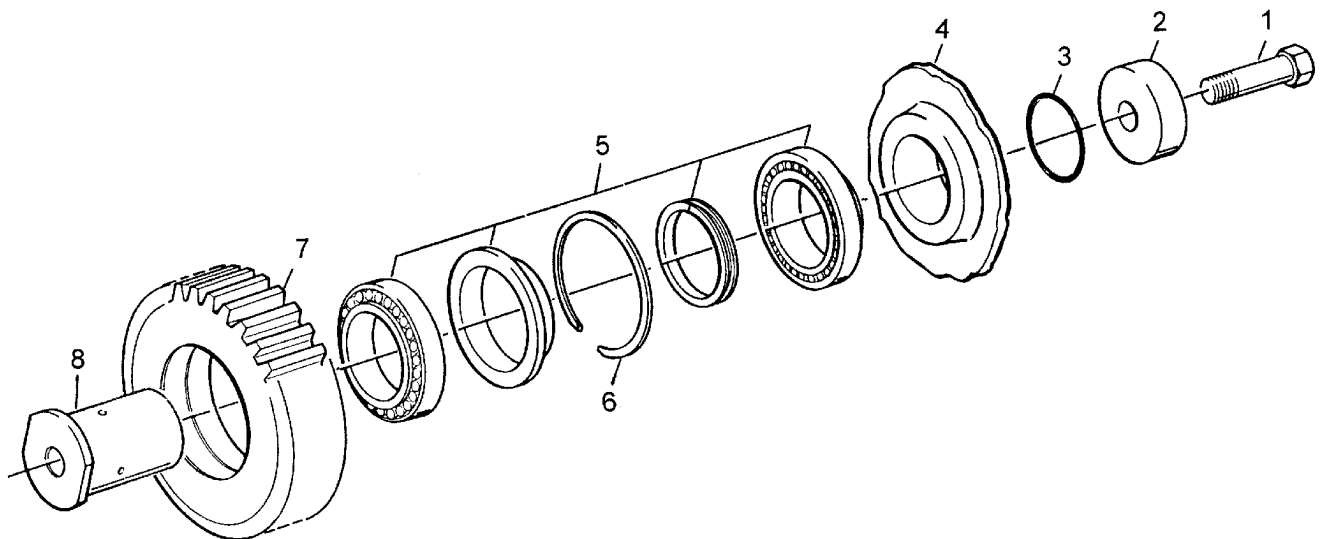


Fig. 7C.23. Exploded View of Reverse Idler Gear

- | | | |
|------------------|---|-----------------------------|
| 1. Mounting Bolt | 4. Rear Cover | 7. Reverse Idler Gear |
| 2. Backing Plate | 5. Double Tapered Roller Bearing Assembly | 8. Reverse Idler Gear Shaft |
| 3. O-Ring | 6. Retaining Ring | |

NOTE: An internal retaining ring (6) separates the two cups inside gear (7).

13. If bearing or shaft replacement is necessary, press bearing cone off shaft (8).

TRANSMISSION

TRANSMISSION

Countershaft (Refer to Fig. 7C.24)

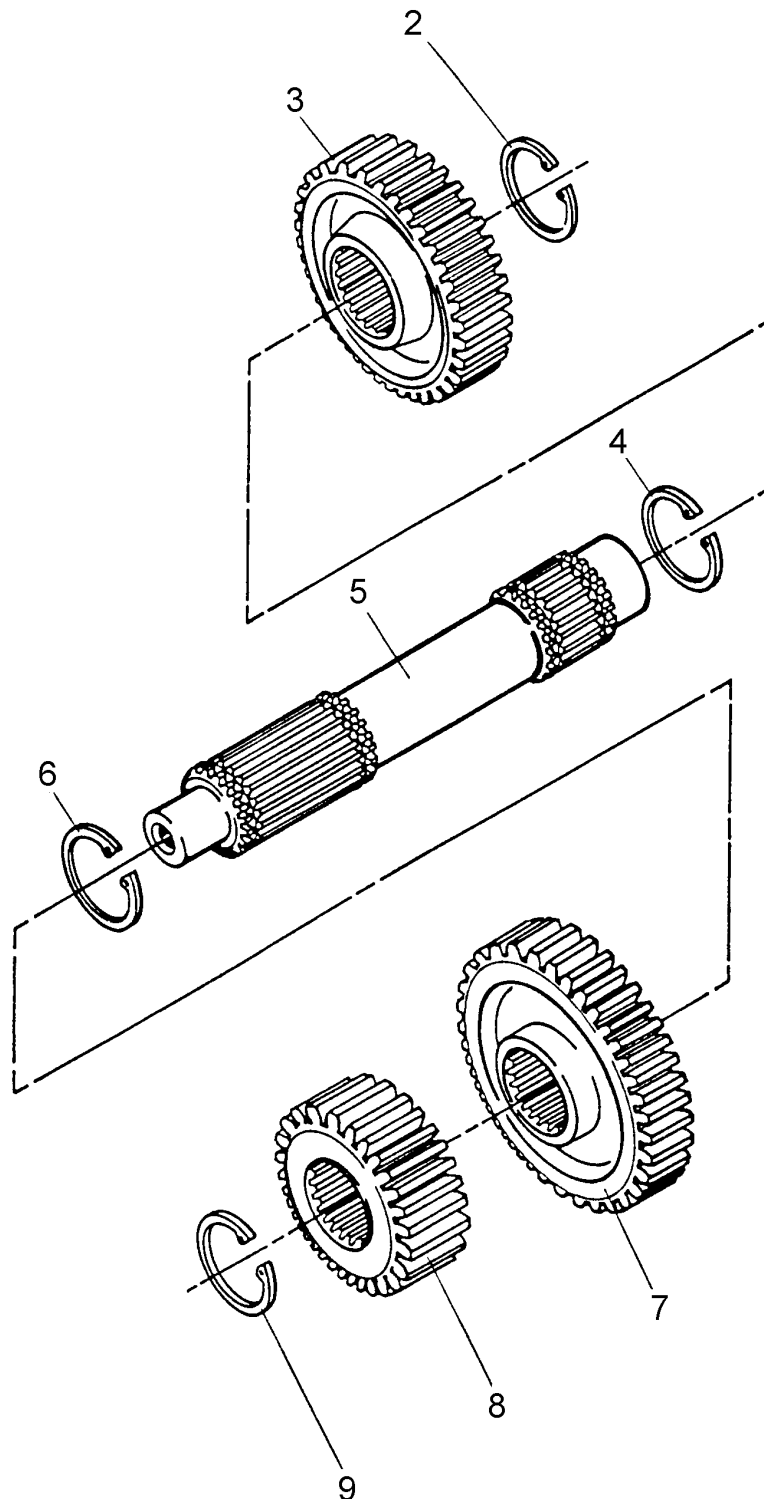


Fig. 7C.24. Exploded View of Countershaft

- | | |
|----------------------|---------------------|
| 2. Retaining Ring | 6. Retaining Ring |
| 3. Second Drive Gear | 7. Third Drive Gear |
| 4. Retaining Ring | 8. First Drive Gear |
| 5. Countershaft | 9. Retaining Ring |

TRANSMISSION

14. Set the shaft on a stand so that gear (8) is up. Remove bearing cone (40, Fig. 7C.6) using bearing puller as shown in Fig. 7C.25.
15. Turn the shaft over the stand so that gear (3) is up. Remove retaining ring (4) from its groove and slide the retaining ring and gear (3) down onto gear (7) as shown in Fig. 7C.26.

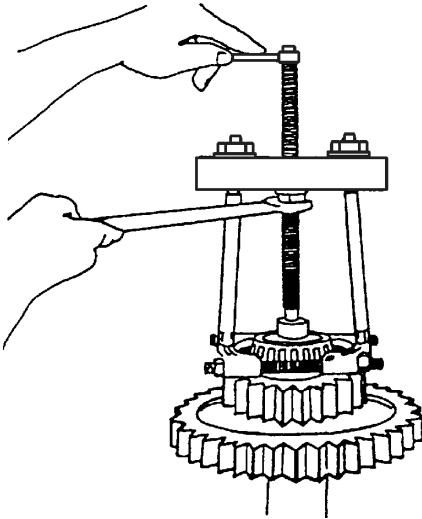


Fig. 7C.25. Removing Bearing Cone

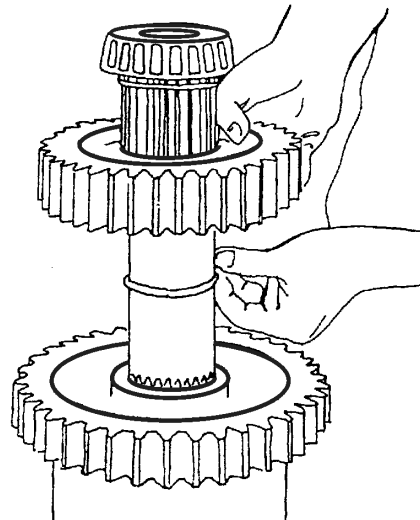


Fig. 7C.26. Lowering Second Drive Gear

16. Remove bearing cone (39, Fig. 7C.6) as shown in Fig. 7C.27. Disassemble component parts in the order (2, 3, 6, 7, 8 and 9) using a press.
17. If bearings (39 and 40, Fig. 7C.6) were replaced, remove bearing cup (39) from cover (1) and remove bearing cup (40) from housing (6).

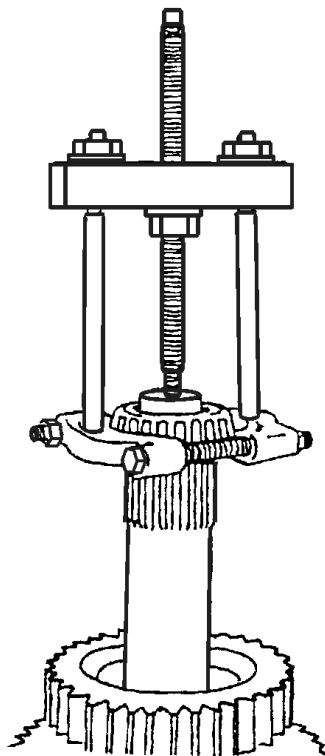


Fig. 7C.27. Removing Bearing Cone

TRANSMISSION

TRANSMISSION

Directional Clutch Shaft (Input Shaft) (Refer to Fig. 7C.28)

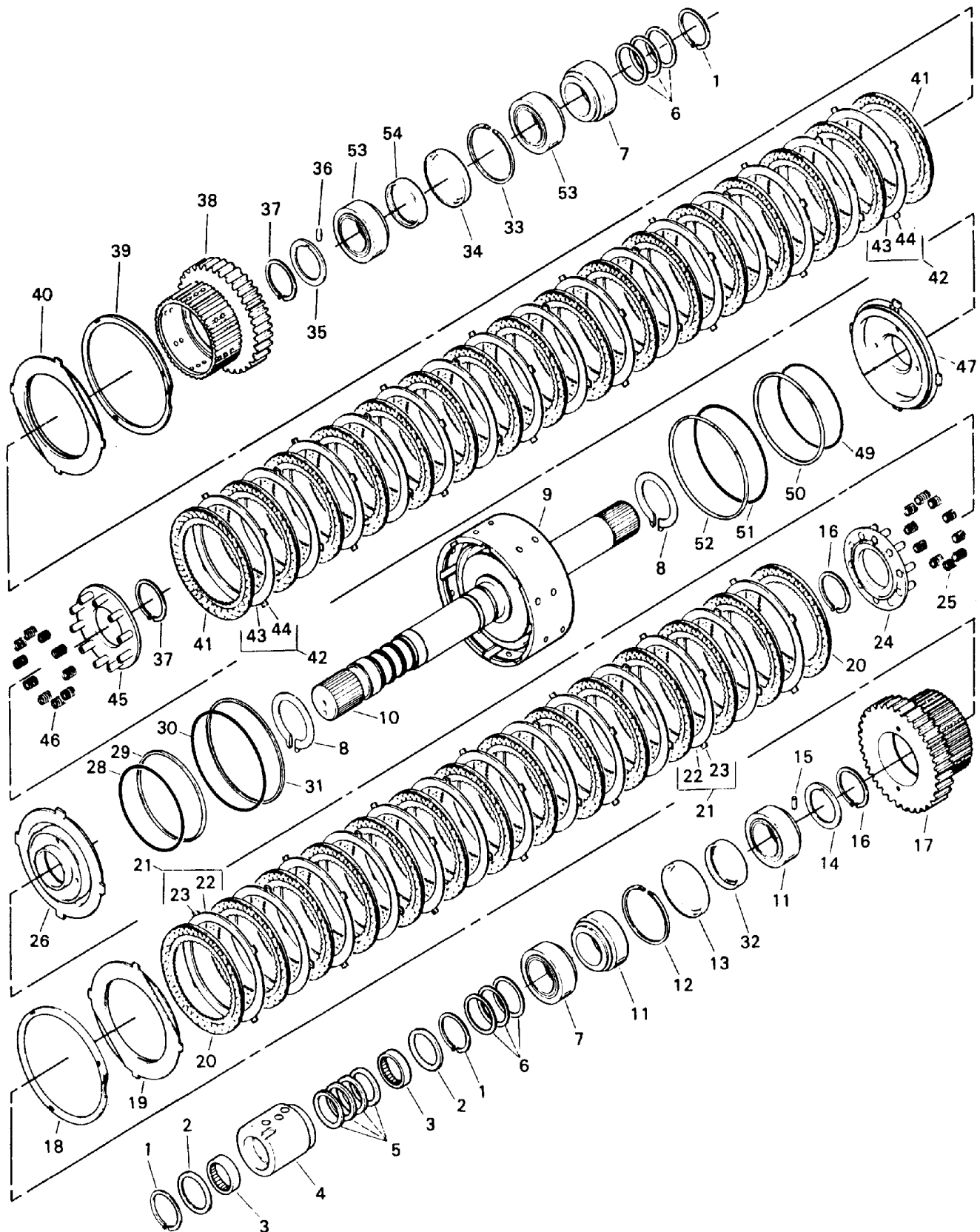


Fig. 7C.28. Exploded View of Directional Clutch Shaft

TRANSMISSION

Legend for Fig. 7C.28

- | | | |
|-------------------------------|------------------------------|------------------------------|
| 1. Retaining Ring | 19. Support Plate | 37. Retaining Ring |
| 2. Roller Thrust Race | 20. Friction Disc | 38. Reverse Gear and Hub |
| 3. Roller Bearing | 21. Separator Plate Assembly | 39. Retaining Ring |
| 4. Oil Manifold | 22. Separator Plate | 40. Support Plate |
| 5. Seal Ring | 23. Rubber Spacer | 41. Friction Disc |
| 6. Shim | 24. Spring Guide | 42. Separator Plate Assembly |
| 7. Tapered Roller Bearing | 25. Piston Return Spring | 43. Separator Plate |
| 8. Retaining Ring | 26. Forward Piston | 44. Rubber Spacer |
| 9. Hub and Drum | 28. O-Ring | 45. Spring Guide |
| 10. Input Shaft (Directional) | 29. Teflon Seal Ring | 46. Piston Return Spring |
| 11. Tapered Roller Bearing | 30. O-Ring | 47. Reverse Piston |
| 12. Retaining Ring | 31. Teflon Seal Ring | 49. O-Ring |
| 13. Cup Spacer Ring | 32. Cone Spacer Ring | 50. Teflon Seal Ring |
| 14. Bearing Spacer Ring | 33. Retaining Ring | 51. O-Ring |
| 15. Dowel Pin | 34. Cup Spacer Ring | 52. Teflon Seal Ring |
| 16. Retaining Ring | 35. Bearing Spacer Ring | 53. Tapered Roller Bearing |
| 17. Forward Gear and Hub | 36. Dowel Pin | 54. Cone Spacer Ring |
| 18. Retaining Ring | | |

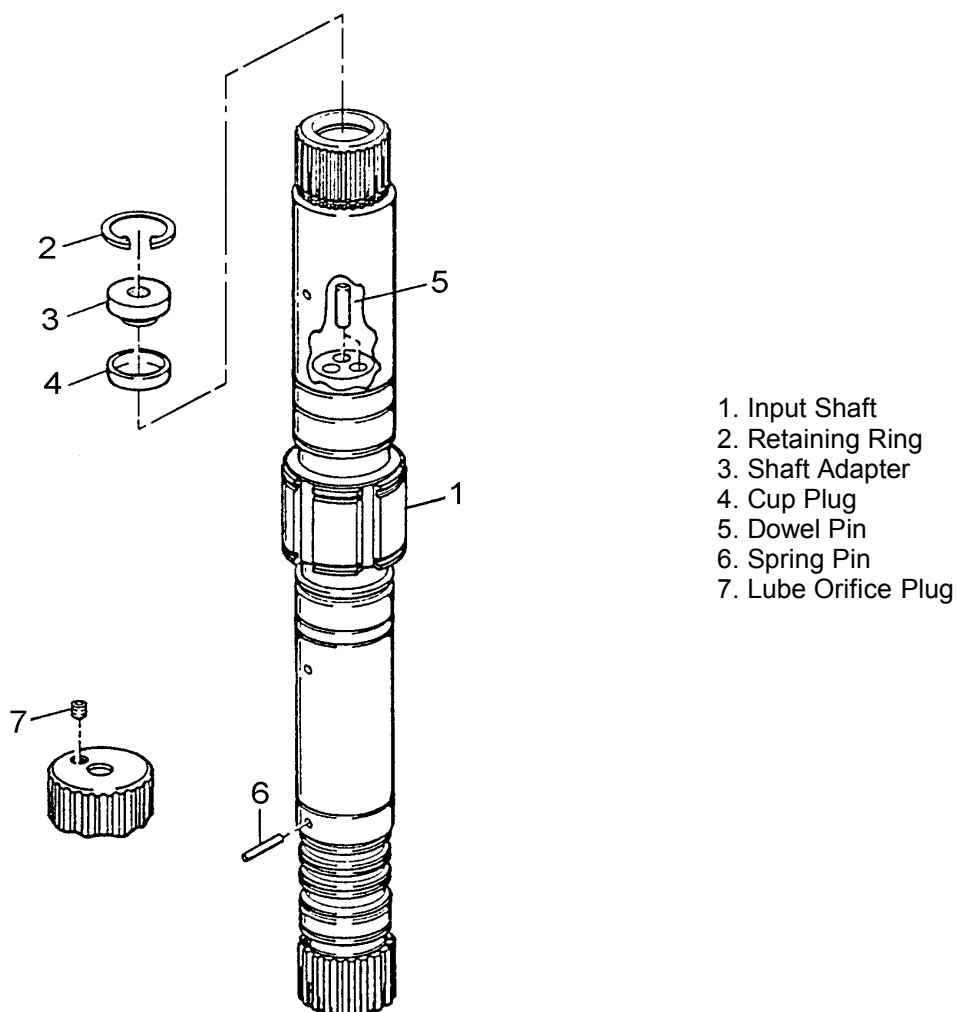


Fig. 7C.28A. Exploded View of Input Shaft (Directional)

TRANSMISSION

TRANSMISSION

NOTE: Unless otherwise notated, following step callouts refer to Fig. 7C.28.

18. Place the shaft in a suitable stand so that the forward gear (17) is up. Remove lube orifice plug from end of the shaft. Inspect orifice to ensure no foreign matter is present. Remove seal rings (5) from clutch shaft. Using M12 tapped holes in gear (17) install a suitable puller (Fig. 7C.29) and remove gear (17) with bearings.

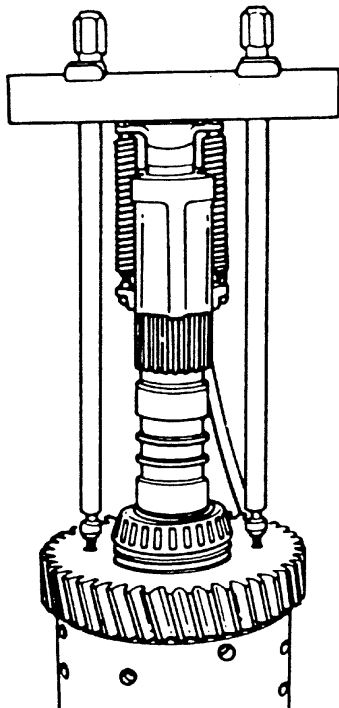


Fig. 7C.29. Removing Bearing Cone

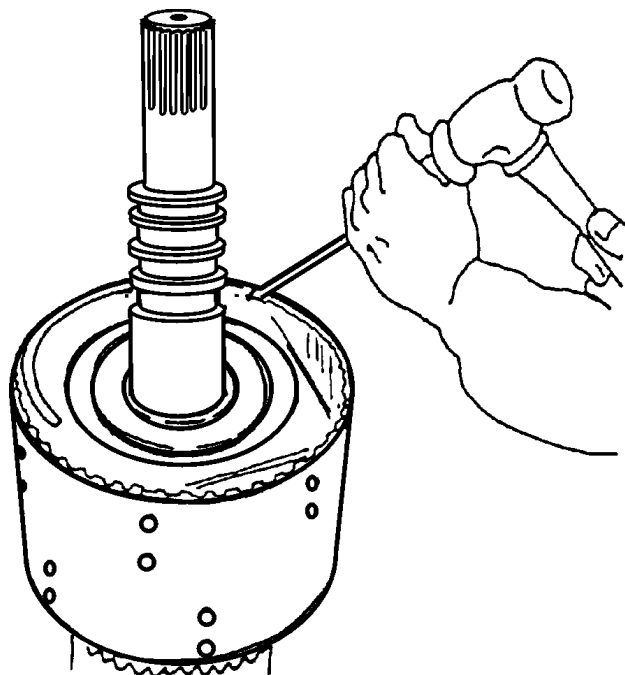


Fig. 7C.30. Removing Retaining Ring

19. Remove bearing cups (11), retaining ring (12) and spacer ring (13) from gear. This is only necessary if gear or bearings are to be replaced. Remove bearing cones (11), dowel pin (15) and spacer ring (14).
20. Remove retaining ring (18) from support plate (19) as shown in Fig. 7C.30. Remove support plate (19). Remove friction discs (20) and separator plates (21) taking note of their sequence for reassembly. Inspect discs (20) for wear and signs of excess heat. Inspect separator plates (21) to insure that spacers (23) are present and not damaged. Refer to SPECIFICATIONS, under TRANSMISSION in this Section for thickness and flatness. Remove retaining ring (16) for bearing spacer.



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.

21. Remove retaining ring (16) for spring guide. This retaining ring is under spring tension. Spring tension can be released by inserting two 400 mm pry bars, 180 [°] apart, through drain holes in clutch drum. Pry down on spring guide (24) to release spring pressure off retaining ring (16). While one person holds spring guide (24) compressed, another person should remove retaining ring (16). Spring tension can be also released by pressing down on spring guide (24) with C clamp as shown in Fig. 7C.31

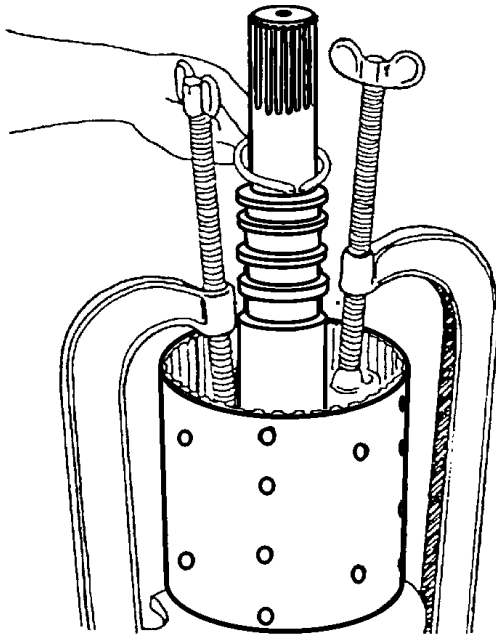
TRANSMISSION

Fig. 7C.31. Compressing Piston Springs

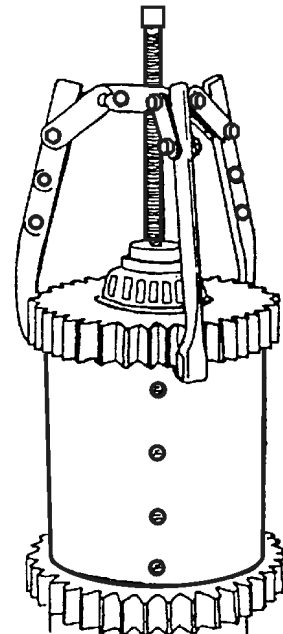


Fig. 7C.32. Removing Bearing Cone

22. Remove spring guide (24) and release springs (25). Remove forward piston (26). Remove and discard O-rings (28 and 30) and seal rings (29 and 31). Turn shaft over to permit access reverse clutch disassembly.
23. With reverse clutch positioned to permit access, remove retaining ring (1) and shims (6). Install a puller and remove gear (38) with bearings (7,53) as in case of gear (17) shown in Fig. 7C.29 or in Fig. 7C.32. Remove bearing cups retaining ring (33) and cup spacer ring (34) from gear. This is only necessary if gear or bearings are to be replaced.



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.

24. Remove bearing cone (53) with cone spacer ring (54), dowel pin (36) and spacer ring (35). Remove retaining ring (39) from support plate (40) and remove discs (41 and 42). Remove retaining ring (37) as previously described in case of retaining ring (16).
25. Remove spring guide (45) and release springs (46) and piston (47). Discard O-rings (49 and 51) and teflon seal rings (50 and 52). If clutch shaft (10) or hub and drum assembly (9) require replacement, proceed as follows to press shaft from hub and drum. Remove retaining rings (8) from clutch shaft (10).
26. If hub/drum must be separated from shaft, place hub/drum and shaft assembly in a press. Support drum to prevent damage and press shaft out of hub/drum assembly.
27. If necessary, disassemble directional clutch shaft components parts (2 through 7, Fig. 7C.28A) from shaft (1).
28. For checking the parts see INSPECTION AND REPAIR, under TRANSMISSION in this Section.

TRANSMISSION

TRANSMISSION

Range Clutch Shaft (Output Shaft) (Refer to Fig. 7C.33)

Legend for Fig. 7C.33

- | | |
|------------------------------|-----------------------------|
| 1. Retaining Ring | 42. 3rd Clutch Gear and Hub |
| 2. Thrust Race | 43. Retaining Ring |
| 3. Roller Bearing | 44. Support Plate |
| 4. Oil Manifold | 45. Friction Disc |
| 5. Seal Ring | 46. Separator Plate |
| 6. Tapered Roller Bearing | 47. Dowel Pin |
| 7. Retaining Ring | 48. Bearing Spacer Ring |
| 8. Shim | 49. Retaining Ring |
| 9. Tapered Roller Bearing | 50. Spring Retainer |
| 10. Output Shaft | 51. Retaining Ring |
| 11. O-Ring | 52. Washer |
| 12. 2nd and 3rd Hub and Drum | 53. Spring Retainer |
| 13. Retaining Ring | 54. Piston Return Spring |
| 14. Retaining Ring | 55. 3rd Clutch Piston |
| 15. Piston Housing | 56. Teflon Seal Ring |
| 16. Teflon Seal Ring | 57. O-Ring |
| 17. O-Ring | 58. Teflon Seal Ring |
| 18. Back-up Ring | 59. Tapered Roller Bearing |
| 19. O-Ring | 60. Bearing Spacer Ring |
| 20. Teflon Seal Ring | 61. Retaining Ring |
| 21. 1st Speed Piston | 62. 2nd Clutch Gear and Hub |
| 22. Piston Return Spring | 63. Retaining Ring |
| 23. Spring Retainer | 64. Support Plate |
| 24. Washer | 65. Friction Disc |
| 25. Retaining Ring | 66. Separator Plate |
| 26. Spring Retainer | 67. Dowel Pin |
| 27. Retaining Ring | 68. Bearing Spacer Ring |
| 28. Shim | 69. Retaining Ring |
| 29. Dowel Pin | 70. Spring Retainer |
| 30. Spacer Ring | 71. Retaining Ring |
| 31. Friction Disc | 72. Washer |
| 32. Separator Plate | 73. Spring Retainer |
| 33. Clutch Drum | 74. Piston Return Spring |
| 34. Support Plate | 75. 2nd Clutch Piston |
| 35. Tapered Roller Bearing | 76. Teflon Seal Ring |
| 36. Retaining Ring | 77. O-Ring |
| 37. Bearing Spacer Ring | 78. Teflon Seal Ring |
| 38. 1st Clutch Gear and Hub | 79. Spring Guide Pin |
| 39. Tapered Roller Bearing | 80. Spring Guide Pin |
| 40. Bearing Spacer Ring | 81. Spring Guide Pin |
| 41. Retaining Ring | |

TRANSMISSION

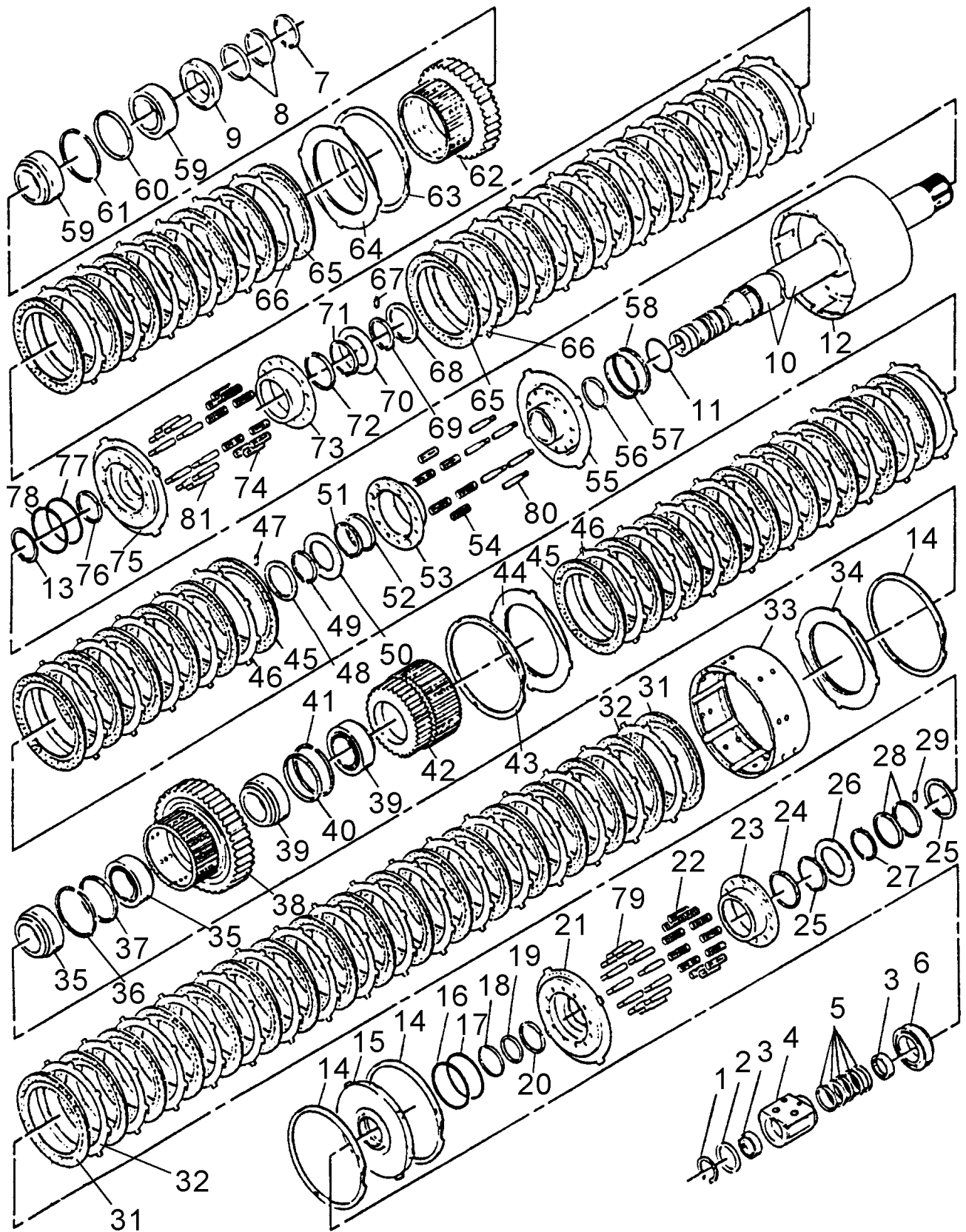


Fig. 7C.33. Exploded View of Range Clutch Shaft

TRANSMISSION

TRANSMISSION

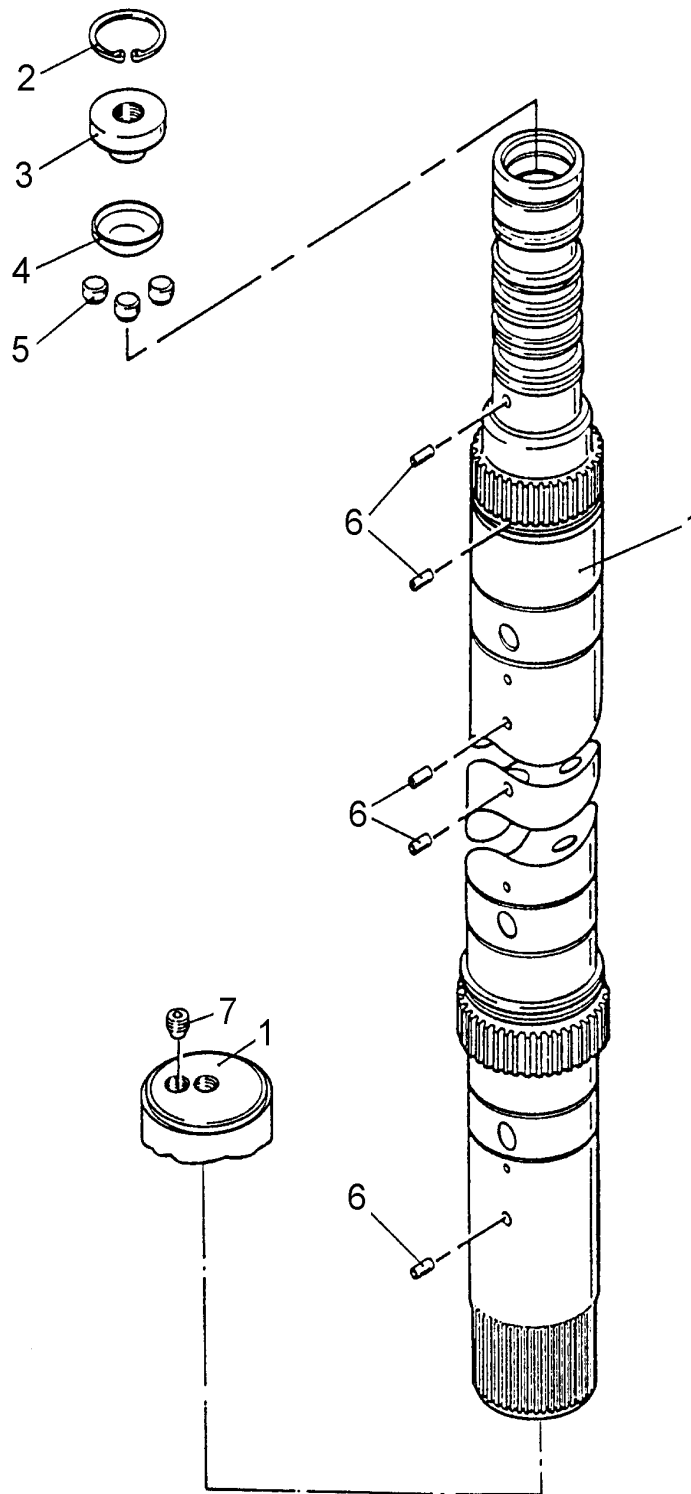


Fig. 7C.33A. Exploded View of Output Shaft (Range)

- | | | |
|-------------------|--------------|----------------------|
| 1. Shaft | 4. Cup Plug | 6. Spring Pin |
| 2. Retaining Ring | 5. Dowel Pin | 7. Lube Orifice Plug |
| 3. Shaft Adapter | | |

TRANSMISSION

NOTE: Unless otherwise notated, following step callouts refer to Fig. 7C.33.

28. Place the shaft in a suitable stand so that the single clutch pack is up.
29. Remove retaining ring (7) and shims (8) from clutch shaft (10). Using tapped holes in gear (62) install a suitable puller (see Fig. 7C.29) and remove gear (62) with bearings. Remove bearing cups (59), retaining ring (61) and cup spacer (60) ring from gear (62).
30. Remove bearing cone (59) from shaft. Remove retaining ring (63) from hub (see Fig. 7C.30). Remove support plate (64). Remove friction discs (65) and separator plates (66) taking note of their sequence for reassembly. Inspect discs and plates for signs of wear and/or excess heat.
31. Remove bearing spacer ring (68), dowel pin (67), retaining ring (69) and spring retainer (70).
32. Remove captured spring piston assembly (71 thru 75). Place piston in a suitable position where two C clamps can be fitted to compress spring retainer (73). Compress assembly (see Fig. 7C.31) and remove retaining ring (71) and washer (72). Then remove C clamps. Remove clutch return springs (74). Inspect spring guides (81) for wear, breakage or looseness. If spring guides are satisfactory, it is not necessary to remove them. If they are removed heat may be required as they are installed with LOCTITE. Remove and discard O-ring (77) and teflon seal rings (76) and (78). Remove retaining ring (13) from shaft (10).



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.

33. From opposite end, remove retaining ring (1), bearing spacer (2) and manifold (4) with roller bearings (3), if not previously removed. Remove teflon seal rings (5). Remove bearing (6) from shaft (10) with a suitable puller. Remove first retaining ring (14) as showed in Fig. 7C.34. Remove piston housing (15) and second retaining ring (14). Remove teflon seal ring (16) O-ring (17), backup ring (18), O-ring (19) and teflon seal ring (20).



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.

34. Remove captured spring piston assembly (21 thru 25) as described above. Place piston in a suitable position where two C clamps can be fitted to compress spring retainer (23). Compress assembly and remove retaining ring (25) and washer (24). Then remove C clamps. Remove clutch return springs (22). Inspect spring guides (79) for wear, breakage or looseness. If spring guides are satisfactory, it is not necessary to remove them. If they are removed heat may be required as they are installed with LOCTITE.
35. Remove friction discs (31) and separator plates (32) with clutch drum (33) together. Remove retaining ring (14) and plate (34). Remove discs and plates from drum taking note of their sequence for reassembly. Inspect discs and plates for signs of wear and/or excess heat.
36. Remove spring retainer (26), retaining ring (27), shims (28), bearing spacer ring (30) and dowel pin (29).
37. Lift first gear and hub (38) with complete bearing (35), bearing spacer ring (37), retaining ring (36) and cap for other bearing (35) as an assembly. This will leave cone for bearing (35) still on shaft. Remove existing bearing cone.
38. Remove third gear and hub (42) with bearing assembly (cup and cone) (39), bearing spacer ring (40), retaining ring (41), cup for bearing (39) as an assembly. Remove existing bearing cone (39) from shaft.

TRANSMISSION

TRANSMISSION

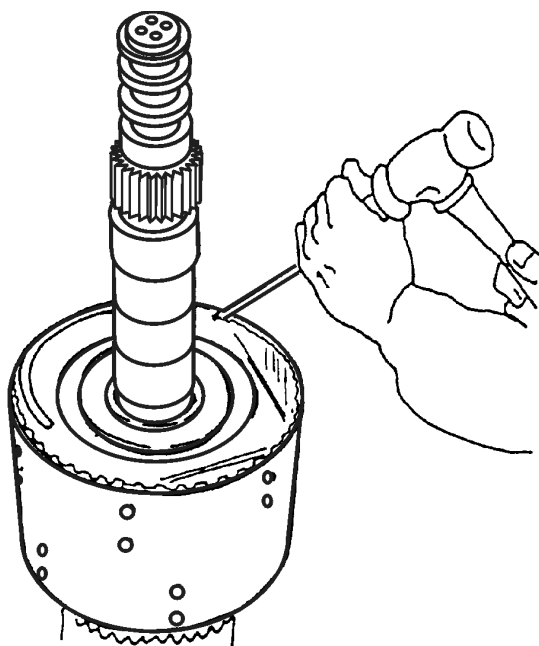


Fig. 7C.34. Removing Retaining Ring

39. Remove retaining ring (43) as showed in Fig. 7C.34 and support plate (44). Remove friction discs (45) and separator plates (46) taking note of their sequence for reassembly. Inspect discs and drive plates for signs of wear and/or excess heat. Remove spacer ring (48) and dowel pin (47).



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.

40. Remove captured spring piston assembly (51 thru 55). Place piston in a suitable position where two C clamps can be fitted to compress spring retainer (53). Compress assembly and remove retaining ring (51) and washer (52). Then remove C clamps. Remove 6 clutch return springs (54). Inspect spring guides (80) for wear, breakage or looseness. If spring guides are satisfactory, it is not necessary to remove them. if they are removed heat may be required as they are installed with LOCTITE. Remove and discard teflon seal ring (58) and O-ring (57) from hub/drum (12) and remove seal ring (56) from shaft (10).
41. If hub/drum (12) must be separated from shaft, place hub/drum and shaft assembly in a press. Support drum to prevent damage and press shaft out. Remove O-ring (11).
42. If necessary, disassemble range clutch shaft components parts (2 through 7, Fig. 7C.33A) from shaft (1).
43. For checking the parts see INSPECTION AND REPAIR, under TRANSMISSION in this Section.

TRANSMISSION

6. INSPECTION AND REPAIR

1. It is recommended that new O-rings, sealing rings and seals be installed whenever the transmission is disassembled for service.
2. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air or a clean cloth.

IMPORTANT: *Do not spin dry bearings with compressed air.*

3. Inspect bearings for excessive wear or damage and replace if necessary. Reusable bearings should be soaked in clean oil and wrapped with clean paper until ready for reassembly.
4. Inspect the gears for worn, chipped or broken teeth. Replace if wear is excessive or teeth are damaged.
5. Inspect the splines on the shafts and drums for wear and check condition of grooves. Replace shafts and drums if wear is excessive. Slight burrs can be smoothed down with a stone.
6. Flush all oil passages of the input and output shafts. Be sure all lube holes are clean and free of obstruction.
7. Inspect the clutch plates for excessive wear, excess heat, cracks or warpage and replace if necessary.
8. Using an oil stone, remove any burrs that might damage sealing surfaces or increase wear to close tolerance parts.
9. Check the compression springs for damage and fatigue. If they do not fall within the tolerances given in SPECIFICATIONS, under TRANSMISSION in this Section, they must be replaced.
10. Inspect I.D. of manifolds (11 and 32, Fig. 7C.6) for wear in seal ring area. If they do not fall within given in SPECIFICATIONS, under TRANSMISSION in this Section, or if a ridge exists from seal ring movement, the manifolds should be changed.

7. REASSEMBLY

NOTE: *All the oil seal rings must be oiled (with same oil as used in the transmission) prior to assembling.*

Range Clutch Shaft (Output Shaft) (Refer to Fig. 7C.33)

1. If removed, reassemble range clutch shaft components parts (2 through 7, Fig. 7C.33A) to shaft (1) in reverse numerical sequence.

NOTE: *Press in five spring pins (6) to shaft (1) holes down to depth $1,3^{+0.8}$ [mm] from shaft surface. Apply LOCTITE P/N 12017 to plug (7) and install it in the shaft (1).*

2. If hub and drum assembly (12) was separated from shaft, install new O-ring (11) on shaft (10). Heat hub and drum assembly to 150 [°C] then position it on shaft so clutch supply holes in shaft align with oil supply holes in hub. After assembling the bigger diameter of hub should be visible from the short end shaft (10) side. Install retaining ring (13).



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.

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TRANSMISSION

3. If spring guides (81) were removed from piston (75) install ten spring guides with LOCTITE P/N 12017. Torque spring guide pins to $80 \pm 10\%$ [Nm] each. Install springs (74) per Fig. 7C.35 on spring guides. Install large spring retainer (73). Using C clamps, compress assembly and install retaining rings (71) and washer (72). Install new O-ring (77) and teflon seal rings (78 and 76). Install piston assembly into hub and secure with retainer (70) and retaining ring (69).
4. Install dowel pin (67) and bearing spacer ring (68). Install 16 friction discs (65) and 15 separator plates (66) starting with a friction disc and ending with a friction disc. Install support plate (64) and retaining ring (63).

NOTE: Coat friction discs with a light film of oil while reinstalling.

5. Install retaining ring (61) into 2nd clutch gear and hub (62). Position bearing spacer (60) against retaining ring at gear end. Press bearing cups (59) into gear and hub (62). Heat one bearing cone to 140 [°C] and install bearing cone onto shaft (10) next to bearing spacer (68). Place gear and hub on shaft (10) insuring that hub splines engage all clutch plates. Heat other bearing cone (59) to 140 [°C] and install on shaft into gear and hub. Lubricate bearings with clean oil when cool. Heat next bearing cone (9) to 140 [°C] and install 3 [mm] above clutch bearing (59) (Fig. 7C.36).

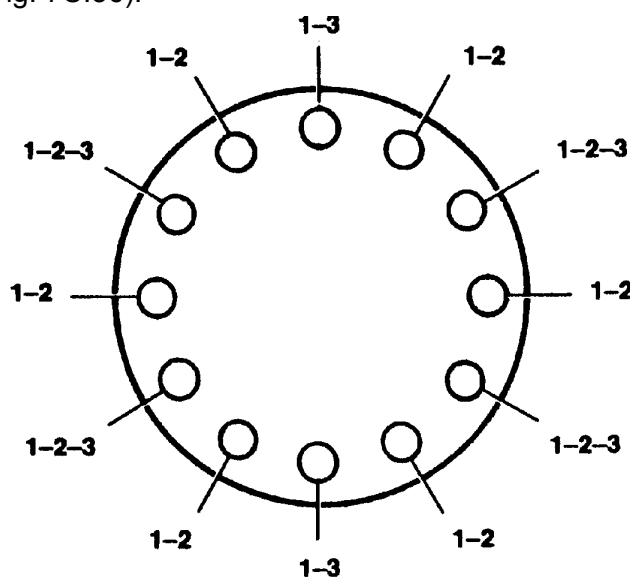


Fig. 7C.35. Spring Arrangement

1. First Speed Clutch

2. Second Speed Clutch

3. Third Speed Clutch

6. Place two thick shims (H, Fig. 7C.36) on shaft bearing so that shim is over bottom edge of retaining ring groove. Place output shaft bridge assembly (refer to SERVICE/ SPECIAL TOOLS in this Section) on top of bearing. When heated bearing cools, determine amount of torque required to take up 3 mm gap. Record this torque. Torque bridge nut 20 [Nm] more to move the bearing to the end. Tap rim of gear in several places with a soft hammer. Retorque to recorded reading. Tap gear again and retorque to recorded reading. Repeat this procedure until torque remains constant. Measure distance from shim to top edge of retaining ring groove (D). Record this reading.

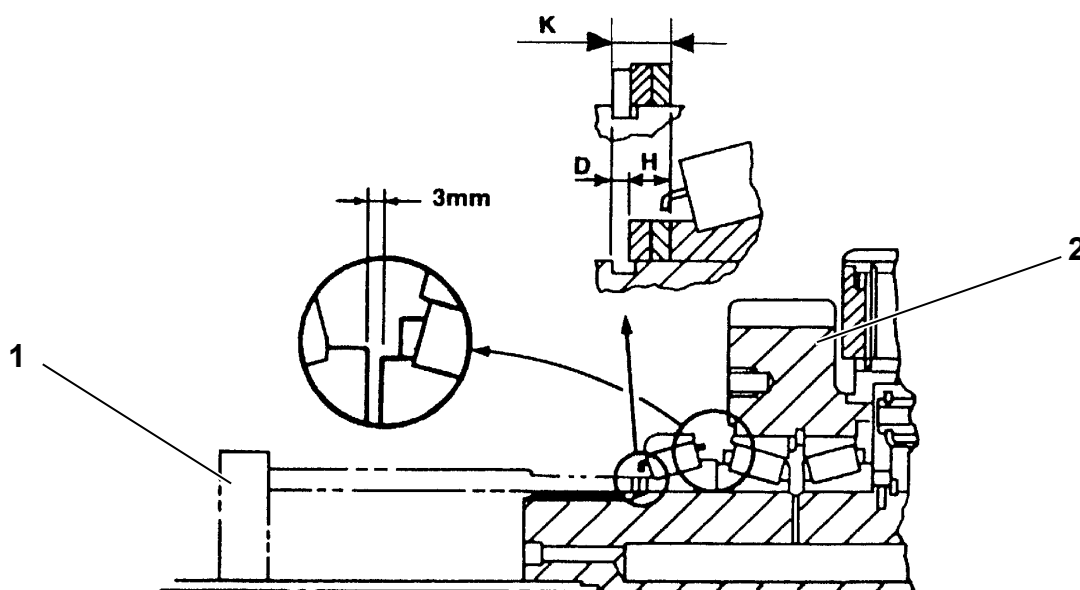
TRANSMISSION

Fig. 7C.36. Second Clutch Bearing Adjustment

1. Bridge Assembly

2. Second Gear

7. Stone faces of retaining ring (7) to remove any burrs and record its thickness. Make up a shim pack (8) consisting of two shims and retaining ring to dimension K.
 $K = D + H + (0 \text{ to } 0.13 \text{ mm})$. Install shim pack and retaining ring. Insure retaining ring is fully seated in groove and thickest shim is towards retaining ring.

NOTE: *It may be necessary to slightly preload retaining ring, shims and bearings in with bridge in order to fully seat retaining ring. Do not exceed recorded torque reached in step 6.*



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.

8. Turn the shaft over. If spring guides (80) were removed from piston (55) install six spring guides with LOCTITE P/N 12017. Torque spring guide pins to $80 \pm 10\%$ [Nm] each. Install six springs (54) per Fig. 7C.35 on spring guides. Install large spring retainer (53). Using C clamps, compress assembly and install retaining ring (51) and washer (52). Install new O-ring (57), teflon seal ring (58) and teflon seal ring (56). Install piston assembly into hub and secure with retainer (50) and retaining ring (49).

NOTE: *Coat friction discs with a light film of oil while reinstalling.*

9. Install dowel pin (47) and bearing retainer (48). Install 15 friction discs (45) and 14 separator plates (46) starting and ending with a friction disc. Install support plate (44) and retaining ring (43).
10. Install retaining ring (41) into 3rd clutch gear and hub (42). Position spacer ring (40) against retaining ring at gear end. Press bearing cups (39) into gear and hub. Heat one bearing cone (39) to $140 [^{\circ}\text{C}]$ and install bearing cone onto shaft (10) next to bearing spacer (48). Place gear and hub on shaft (10) insuring that hub splines engage all clutch plates. Heat other bearing cone to $140 [^{\circ}\text{C}]$ and install on shaft into gear and hub. Lubricate bearings with clean oil when cool. Heat next bearing cone (35) to $140^{\circ} [^{\circ}\text{C}]$ and install onto shaft (10).

TRANSMISSION

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11. Install retaining ring (36) into 1st clutch gear and hub (38). Position bearing spacer (37) against retaining ring at gear end. Press bearing cups into gear and hub. Install first gear. Heat remaining bearing cone (35) to 140 [°C] and install bearing cone onto shaft (10). Lubricate shaft and bearings with clean oil after bearing cools. Insert dowel pin (29) and bearing spacer (30).

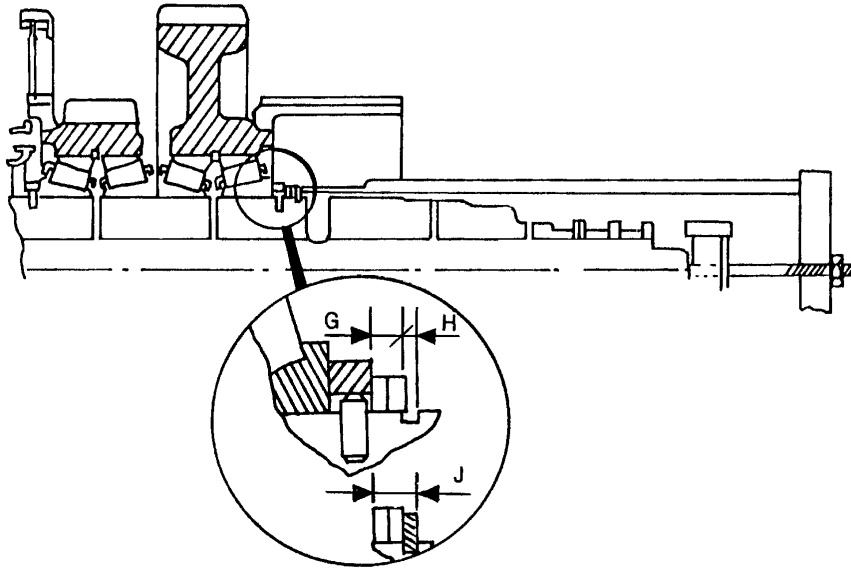


Fig. 7C.37. First and Third Bearing Adjustment

12. Place two thick shims (28) (G, Fig. 7C.37) on bearing retainer (30) so that top face of shim is above bottom edge of retaining ring groove. Place clutch bridge assembly (refer to SERVICE/ SPECIAL TOOLS in this Section) on top of shims. Torque bridge nut to 20 [Nm].

NOTE: Care should be taken to avoid puncturing or deforming lube cup plug in end of shaft when torque is applied.

13. Tap rim of first gear in several places with a soft faced hammer while rotating first gear. Retorque nut to 20 [Nm]. Tap and rotate gear until torque stabilizes. Measure distance from top face of shim to upper edge of retaining ring groove. Record this dimension (H, Fig. 7C.37). Measure ring thickness G. Remove bridge assembly. Stone both sides of retaining ring (27).

$J = G + H + (0 \text{ to } 0.13 \text{ [mm]})$. Make up a shim pack consisting of two shims (28) and a retaining ring (27) to J dimension. Install shim pack. Install retaining ring. Insure it is fully seated in shaft groove.

NOTE: Bridge assembly can be used to assist in installation of retaining ring by torquing bridge nut to 20 [Nm].



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.

14. Install spring retainer (26). If spring guides (79) were removed from piston (21) install 12 spring guides with LOCTITE P/N 12017. Torque spring guide pins to $80 \pm 10\%$ [Nm] each. Install 12 springs (22) per Fig. 7C.35 on spring guides. Install large spring retainer (23). Using C clamps, compress assembly and install washer (24) and retaining ring (25). Install a new teflon seal ring (20) on shaft in small groove. This ring seals piston to shaft.

TRANSMISSION

15. Install support plate (34) into clutch drum (33) and secure it with retaining ring (14). Install 17 friction discs (31) and 16 separator plates (32) starting with a friction disc and ending with a friction disc. Install piston (21) with springs and retainer. Install O-ring (19) and backup ring (18) in wide groove in shaft. Install retaining ring (14). Install O-ring (17) and teflon seal ring (16) on clutch piston housing and lubricate seals.
16. Position piston housing (15) on shaft and align tabs with drum clutch slots. With a rubber or teflon mallet, drive piston housing over O-ring (19) and backup ring (18). Install spiral (outer) retaining ring (14).

NOTE: To insure proper assembly of first speed components, measure dimension *M* shown in Fig. 7C.38.

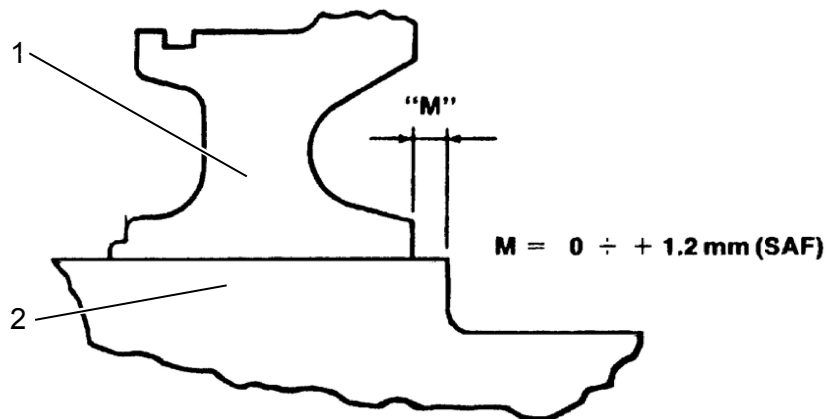


Fig.7C.38. Dimension „M“

1. First Speed Clutch Hub 2. Shaft

17. Heat bearing cone (6) to 140 [°C] and install outer bearing. Install new seal rings (5) and lubricate with grease; align rings. Install needle bearings (3) in manifold (4). Do not install manifold at this time

Directional Clutch Shaft (Input Shaft) (Refer to Fig. 7C.28)

18. If removed, reassemble range clutch shaft components parts (2 through 7, Fig. 7C.28A) to shift (1) in reverse numerical sequence.

NOTE: Press in five spring pins (6) to shaft (1) holes down to depth $1,3^{+0.8}$ [mm] from shaft surface. Apply LOCTITE P/N 12017 to plug (7) and install it in the shaft (1).

19. If hub and drum assembly was separated from shaft, install one retaining ring (8) on shaft. Heat hub and drum assembly to 150 [°C] then position hub and drum assembly on shaft so clutch oil supply holes in shaft align with oil supply holes in hub and drum assembly. Forward clutch side of hub and drum assembly faces manifold seal ring grooves (four) and input spline on shaft. Forward clutch side of hub and drum assembly is identified by a small step on outside diameter of piston cavity (Fig. 7C.39). Support hub and drum assembly on shaft and push shaft into hub and drum assembly until it bottoms on previously installed retaining ring (8). Install other retaining ring (8) on shaft to retain hub and drum assembly. Allow assembly to cool.

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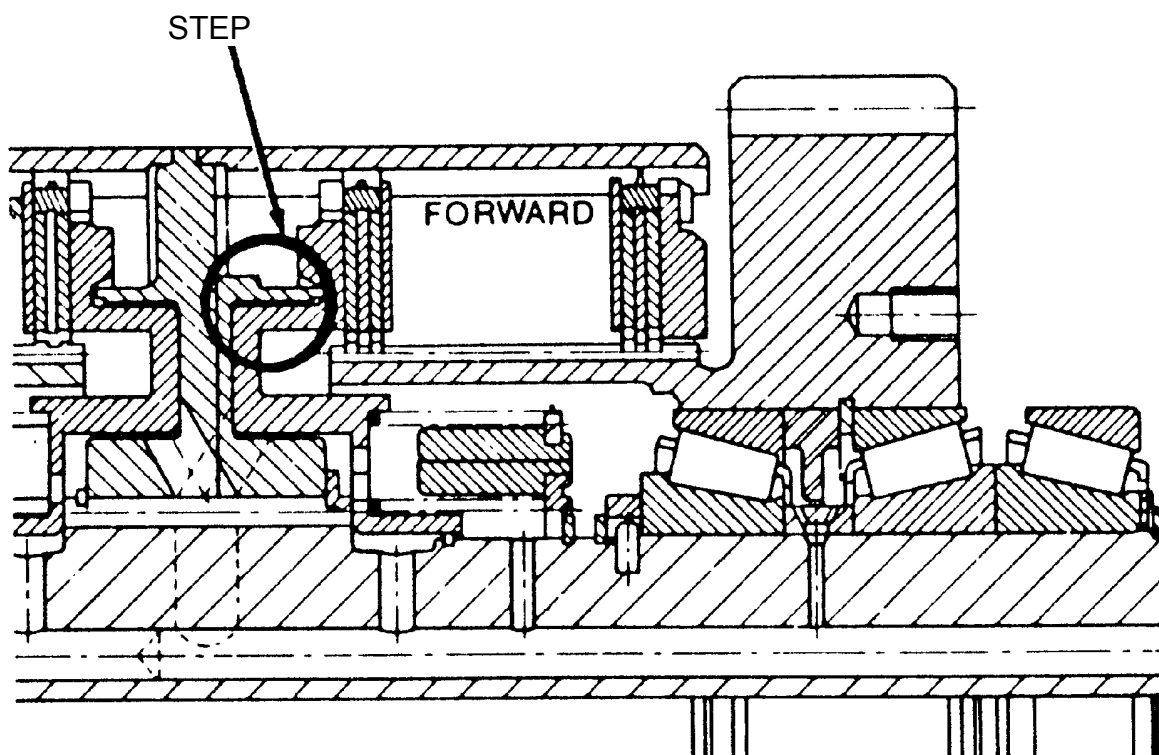


Fig. 7C.39. Piston Cavity

20. Install new O-rings (28 and 30) and teflon seal rings (29 and 31) on hub and drum (9) and forward piston (26). Lightly grease teflon seals then install forward piston (26).
21. Install ten piston return springs (25) and spring guide (24). Using C clamps or compressing tool (refer to SERVICE/SPECIAL TOOLS in this Section) install retaining ring (16) on shaft (spring guide).



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.

NOTE: Coat discs with a light film of oil while reinstalling.

22. Install second retaining ring (16) on shaft. Install dowel pin (15). Install bearing spacer ring (14). Replace any damaged or missing rubber spacers (23). Install 14 friction discs (20) and 13 separator plates (21) starting with a friction disc, then a separator plate with rubber spacers, a friction disc, a separator plate without spacers, etc. and ending with a friction disc. Install support plate (19) and retaining ring (18).

NOTE: Following step 23 through 33 are used to establish a bearing preload adjustment on forward and reverse hub gears. If in doubt about cone spacer selection, while performing these steps always use a cone spacer which will yield lighter preload. A bearing excessively preloaded could fail after a very short operation period.

23. Install retaining ring (12) and red bearing cup spacer ring (13) 13.08 [mm] into gear (17). Press bearing cups into gear (17) making sure cups are seated against retaining ring and red bearing cup spacer. Apply a light film of oil to bearing cups.

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24. Using an arbor press, place a bearing cone on press (Fig. 7C.40). Install black cone spacer ring (32) 16.561 [mm] onto bearing cone (Fig. 7C.41). Set gear (17) onto bearing cone and spacer ring. Install remaining bearing cone into gear (17) (Fig. 7C.42).

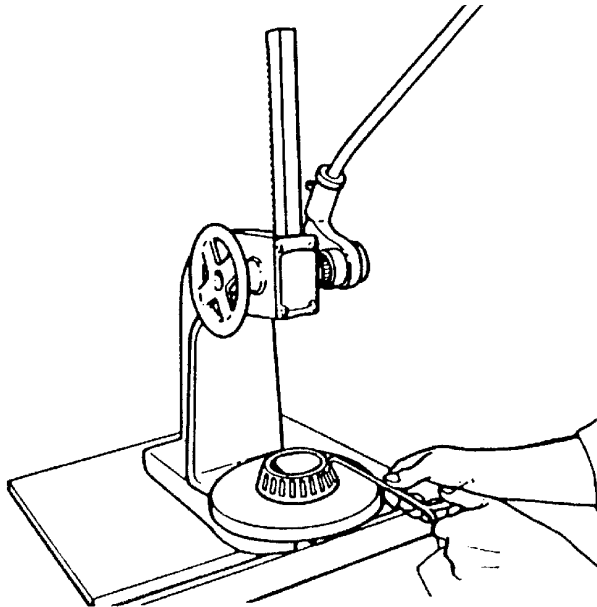


Fig. 7C.40. Bearing Cone

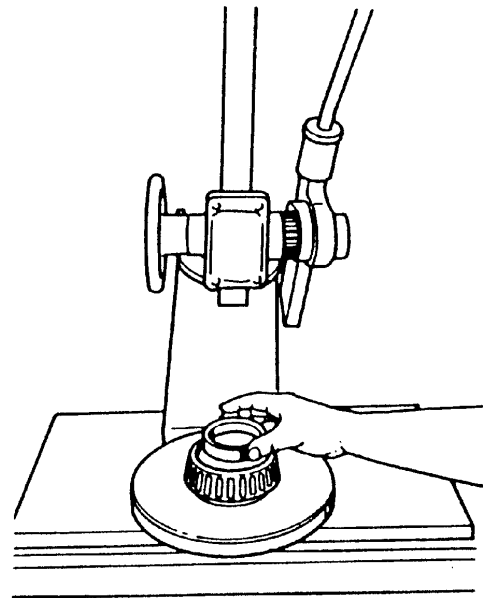


Fig. 7C.41. Black Bearing Cone Spacer

25. Press the bearing cone with 700 [N] load on arbor press, while rotating the gear with the other hand (Refer to Fig. 7C.43).

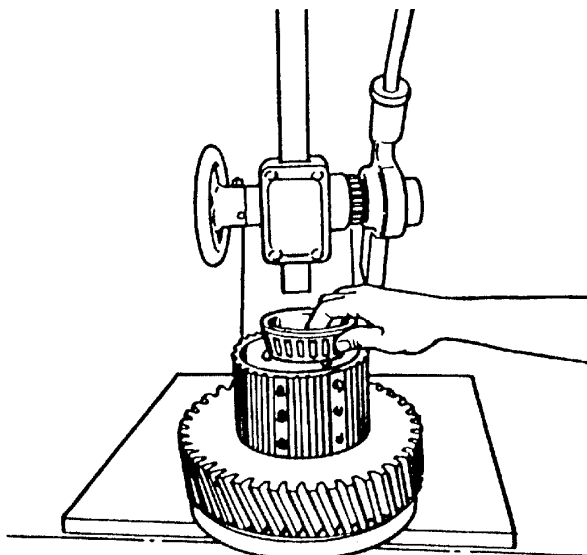


Fig. 7C.42. Gear and Bearing Cone Installed

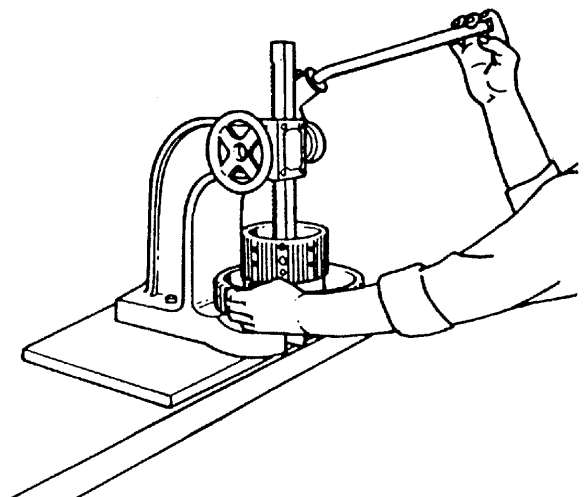


Fig. 7C.43. Rotating Gear under Force

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26. If gear with black bearing cone spacer does not spin freely, change red bearing cup spacer ring to a blue bearing cup spacer ring 12.825 [mm] and redo Step 23.

NOTE: *If after repeating step 25 gear still does not spin freely with blue bearing cup spacer ring, then parts are out of tolerance or wrong parts were used. Consult your local distributor.*

27. If gear spins freely after increasing force lightly by hand, replace black bearing cone spacer ring with a red bearing cone spacer ring 16.485 [mm].
28. If gear with red bearing cone spacer ring does not spin freely, bearing cup and cone spacers rings are correct and can be installed in clutch pack.
29. If gear with red bearing cone spacer ring spins freely, replace red bearing cone spacer ring with an orange bearing cone spacer ring 16.408 [mm] and repeat process.
30. If gear with orange bearing cone spacer ring does not spin freely, bearing cup and cone spacers rings are correct and can be installed in clutch pack.
31. If gear with orange bearing cone spacer ring spins freely, replace orange bearing cone spacer ring with a yellow bearing cone spacer ring 16.332 [mm] and repeat process.
32. If gear with yellow bearing cone spacer ring does not spin freely, bearing cup and cone spacers rings are correct, and can be installed in clutch pack.
33. If gear with yellow bearing cone spacer ring spins freely, replace yellow bearing cone spacer ring with a green bearing cone spacer ring 16.256 [mm] and repeat process.

NOTE: *Refer to bearing adjustment and installation chart (Fig. 7C.44) for quick reference to bearing cup and cone combinations and options.*

34. After correct combination of bearing cup ring and cone spacers rings has been determined, they are to be assembled onto shaft as a group. Heat one bearing cone (11) to 140 [°C] and install it on shaft down to bearing spacer ring (14), oil bearing when it cools. Install retaining ring (12), preselected bearing cup spacer ring (13) and press two bearing cups into gear (17). Install bearing cone spacer ring (32) (preselected) to bearing cone after preheating to 200 [°C]. Install gear (17) on shaft; pay attention to correct friction discs and gear drum mesh. Heat second bearing cone (11) to 140 [°C] and install it on shaft, oil bearing when it cools. Heat third bearing cone (7) to 140 [°C] and install it on shaft (Fig. 7C.45).
35. Place two thick shims (6), after measuring their thickness B, on bearing cone so that top face of shim is above bottom edge of retaining ring groove. Install clutch bridge assembly (refer to SERVICE / SPECIAL TOOLS in this Section) (Fig. 7C.46) to top of third bearing. Apply 100 [Nm] of torque to nut while rotating and tapping rim of gear with a soft hammer until torque stabilizes. Allow assembly to cool with bridge in place. Measure distance from top face of shim to upper edge of retaining ring groove with a feeler gauge (Dimension A, Fig. 7C.46). Record it. Stone faces of retaining ring (1) and record its thickness. Determine the shim pack thickness and retaining ring to dimension (A+B). When shim pack thickness is determined, install with thickest shim toward retaining ring.
36. Install retaining ring (1). Insure it is fully seated in shaft groove. Install thrust race (2) and roller bearing (3) and new seal rings (5) on the shaft. Lightly grease rings to hold seal rings in position and reduce friction when manifold is installed. Install bearings (3) in manifold (4). Do not install manifold at this time. Position shaft to allow access to assemble reverse side.
37. Install new O-rings (49 and 51) and teflon seals (50 and 52) on hub and drum (9) and reverse piston (47). Lightly grease teflon seals then install reverse piston. Install ten piston return springs (46) and spring guide (45).

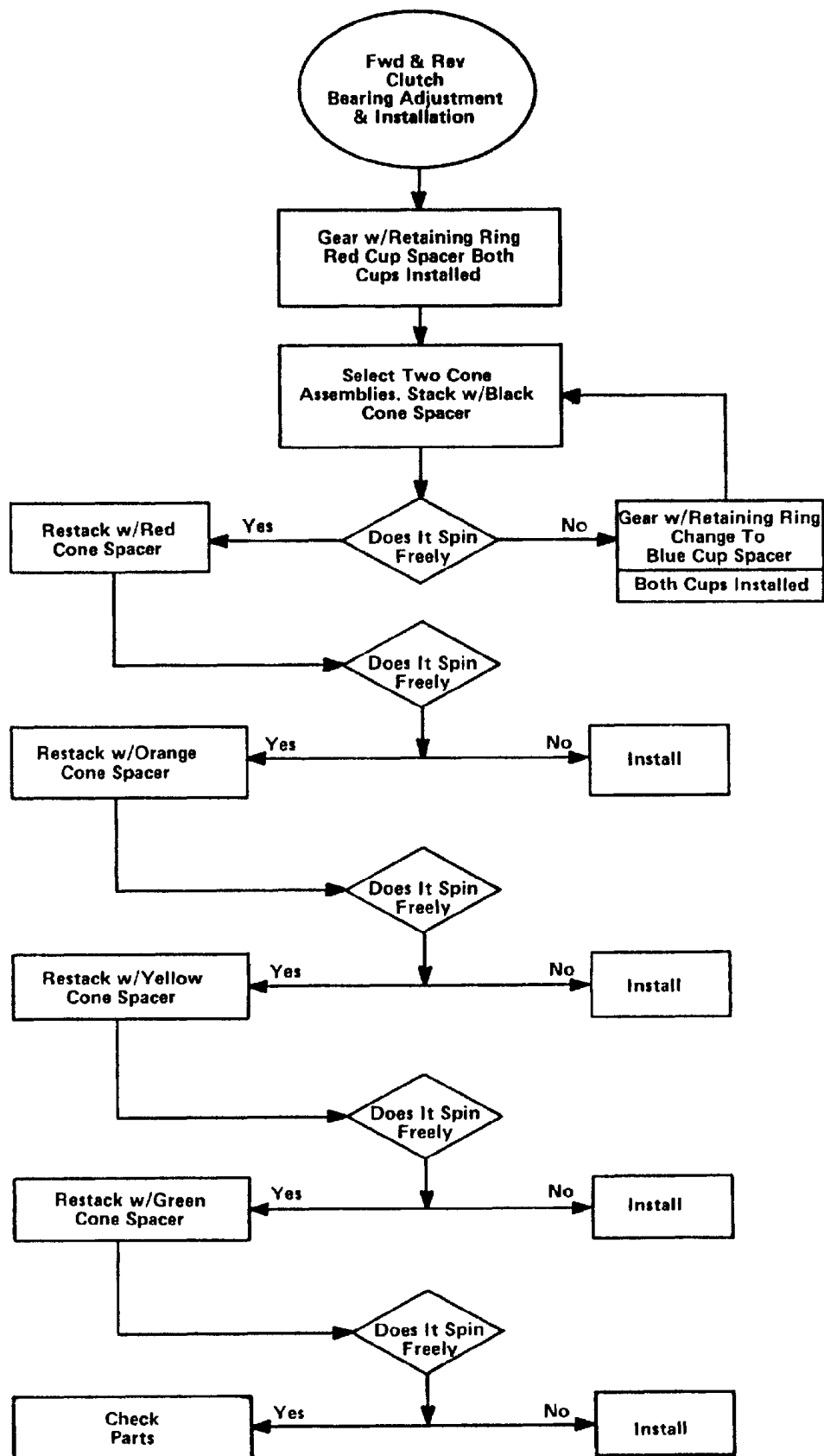
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Fig. 7C.44. Bearing Adjustment and Installation Chart

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Fig. 7C.45. Bearing Cone Installation

Fig. 7C.46. Shim Pack Thickness



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when assembling.

38. Install retaining ring (37) on shaft (spring guide). Refer to Step 21 in DISASSEMBLY under TRANSMISSION for compressing springs.
39. Install retaining ring (37) on shaft to support bearing spacer. Install dowel pin (36) and bearing spacer ring (35). Install 16 friction discs (41) and 15 separator plates (42) starting with a friction disc, then a separator plate with rubber spacers, a friction disc, a separator plate without spacers, etc. and ending with a friction disc. Replace any damaged or missing rubber spacers (44). Install support plate (40) and retaining ring (39).

NOTE: *Coat discs with a light film of oil while reinstalling.*

40. Establish correct reverse gear bearing adjustment as outlined in Steps 23 thru 33. After correct combination of bearing cup and cone spacers has been determined, they are to be assembled onto shaft as a group.
41. Heat one bearing cone (53) to 140 [°C] and install it on shaft down to bearing spacer ring (35), oil bearing when it cools. Install retaining ring (33), preselected bearing cup spacer ring (34) and press two bearing cups into gear (38). Install bearing cone spacer ring (54) (preselected) to bearing cone after preheating it to 200 [°C]. Install gear (38) on shaft; pay attention to correct friction discs and gear drum mesh. Heat second bearing cone (53) to 140 [°C] and install second bearing cone, oil bearing when cool. Heat third bearing cone (7) to 140 [°C] and install it on shaft.
42. Place two thick shims (6) after measuring their thickness B on bearing retainer so that top face of shim is above bottom edge of retaining ring groove. Install clutch bridge assembly (refer to SERVICE / SPECIAL TOOLS in this Section) to top of third bearing. Torque to 100 [Nm] while rotating and tapping rim of gear with a soft hammer until torque stabilizes. Allow assembly to cool with bridge in place. Use care to avoid puncturing or deforming cup plug in end of shaft.

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43. Measure distance from top face of shim to upper edge of retaining ring groove with a feeler gauge (Distance A, Fig. 7C.46). Record it. Stone faces of retaining ring (1) and record its thickness. Determine the shim pack thickness and retaining ring to dimension (A+B). When shim pack thickness is determined, remove bridge and install shim pack with thickest shim toward retaining ring. Install retaining ring (1). Insure it is fully seated in shaft groove. Install the lube orifice plug on the end of shaft, if removed.

Countershaft (Refer to Fig. 7C.24)

44. Install retaining rings (6) and (4) on shaft (5) if removed. Heat gear (3) to 135 [°C] and install it on shaft (5). Install retaining ring (2).
45. Heat bearing cone (39, Fig. 7C.6) to 140 [°C] and install on shaft. Heat gears (7) and (8) to 140 [°C] and install gear (7) first, then install gear (8). Install retaining ring (9). Heat bearing cone (40, Fig. 7C.6) to 140 [°C] and install on shaft.
46. If bearings (39 and 40, Fig. 7C.6) were replaced, press new bearing cup (39) in cover (1) and press new bearing cup (40) in housing (6) with depth not less than 0.04 [mm].

Reverse Idler Shaft (Refer to Fig. 7C.23)

47. If bearings (5) or gear (7) were replaced, check that retaining ring (6) is properly seated in the groove inside gear (7) and press one cup of bearing (5) in the gear bore until it bottoms on retaining ring (6). Turn the gear (7) over and press the second cup of bearing (5) in the gear bore until it bottoms on retaining ring (6).
48. If bearings (5) or shaft (8) was replaced, heat bearing cone (5) to 140 [°C] and install on shaft (8) until it bottoms. To assure cone is seated, keep pressure against the cone until it cools a few seconds
49. Heat second bearing cone (5) to 140 [°C] and install on shaft (8) until it bottoms. To assure cone is seated, keep pressure against the cone until it cools a few seconds.

Transmission Housing and Rear Cover (Refer to Fig. 7C.6)

NOTE: Unless otherwise notated, following step callouts refer to Fig. 7C.6.

Rear Cover

50. All bearing cups if removed should be pressed in and solidly shouldered in their respective bores. Check with 0.05 [mm] feeler gauge between cup and transmission shoulder for clearance (zero clearance required).
51. Install reverse idler gear (5, Fig. 7C.47) if removed with shaft and bearings in rear cover. Insert a new O-ring (3) in shaft bore of cover. Insert retaining bolt (1) through spacer (2). Thread bolt (1) into gear assembly (5). Torque bolt to $385 \pm 10\%$ [Nm].

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Clutches, Shaft and Countershaft (Refer to Fig. 7C.6)

52. With rear cover (1) placed in a horizontal position as showed in Fig. 7C.48.and bearing cups lightly greased and pressed solidly into their respective bores and against their shoulders, attach a hoist to the eyebolt M12 range clutch assy (3) and lower the shaft on cover (1). Do not set the shaft all way down.
53. Install shafts (2 and 5) on cover (1) as shown in Fig. 7C.48 and lower shaft (3) all the way down. Remove the hoist and eyebolt.
54. Before baffle installation place the magnet (38) in the baffle (37). Position baffle (37) on cover (1) and secure it with the five bolts and washers. Torque the bolts with washer to $106 \pm 10\%$ [Nm]. To secure one of the bolts a long extension with a swivel adapter can be inserted in the baffle opening as shown in Fig. 7C.49.

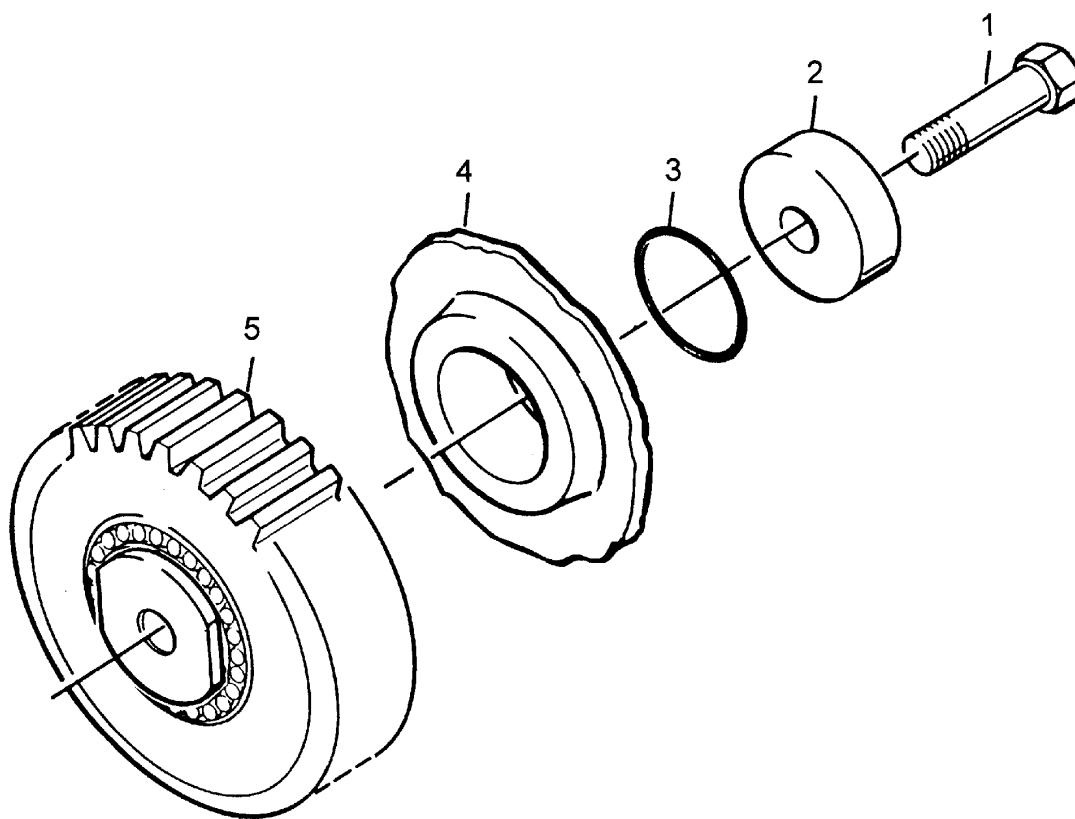


Fig. 7C.47. Reverse Idler Gear Installation

- | | |
|------------------|--|
| 1. Mounting Bolt | 4. Rear Cover |
| 2. Spacer | 5. Reverse Idler Gear Assembly
(Shaft and Tapered Bearings) |
| 3. O-ring | |

55. Insert tubes (7) through the openings in housing (6).
56. The front bearing cup for countershaft should be pressed into its bore in retainer and directional and range cups should also be pressed into their respective bores in manifolds (11 and 32). Press dowels in place in case flange if they were removed.

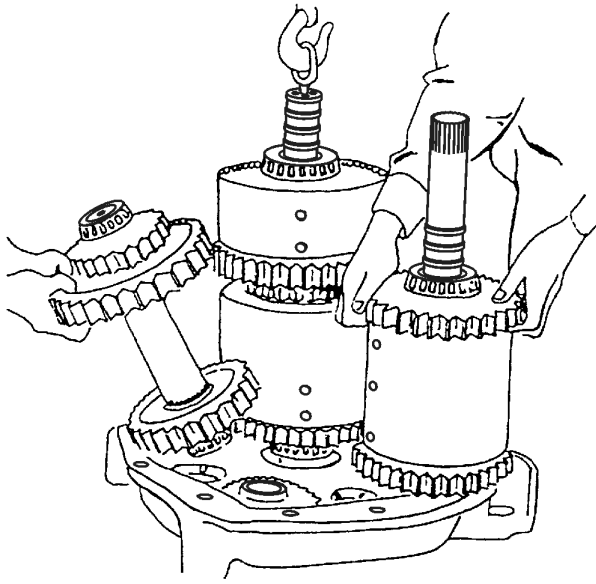
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Fig. 7C.48. Shafts Installation

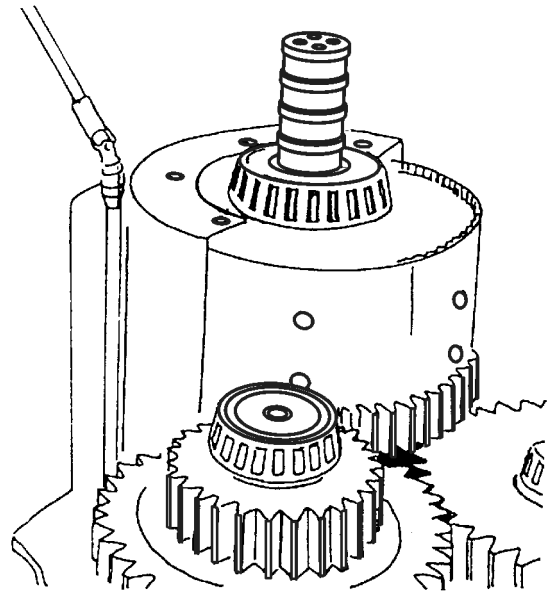


Fig. 7C.49. Baffle to Cover Bolt

57. Apply LOCTITE #515 Flange Sealant (purple color) to flange surface of cover (1). With input (11) and output (32) manifolds and countershaft (14) cup retainer removed from housing (6), lower housing over rear cover (1) as shown in Fig. 7C.50 guiding upper end of three shaft assemblies into their respective bores in case until mating surfaces of housing (6) and cover (1) are contacting each other. When housing and cover flange surfaces are in full contact and doweled together, install and torque housing and cover bolts to $80 \pm 10\%$ [Nm].
58. Secure baffle (37) to housing (6) with four bolts and washers previously removed as shown in Fig. 7C.51. Torque the bolts with washers to $80 \pm 10\%$ [Nm].

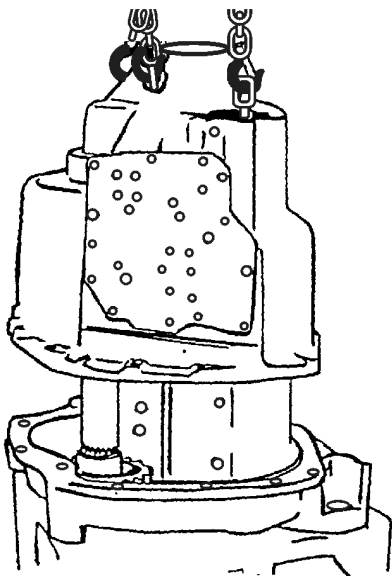


Fig. 7C.50. Transmission Housing Installation

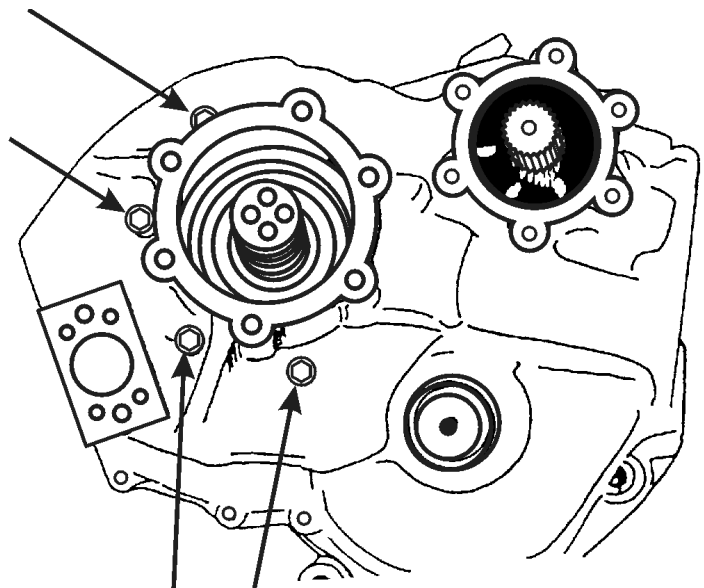


Fig. 7C.51. Baffle to Housing Bolts

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Bearing Adjustment and Checking Procedure

NOTE: Unless otherwise notated, following step callouts refer to Fig.7C.6.

NOTE: When placing the manifold over the shaft insure the clutch oil supply holes are aligned, if applicable. Never exert a downward force on the manifold as this will damage to seal rings. Support the majority of weight of the manifold during this process. Do not allow the manifold to free fall. If the manifold does not slide fully into place without encountering resistance, lightly tap side of manifold from side to side to align it properly.

Continue to tap and align manifold sides until the manifold drops over each seal ring. If the manifold fails to drop easily into place, it is an indication that the seal rings may not have been centered on the shaft and may be damaged. If damage is suspected, remove the manifold, inspect the seal ring and repeat the procedure.

Adjust input, output and countershaft end play to 0.13 – 0.25 [mm]. Lightly grease the input shaft manifold and output shaft manifold outside diameter and leave O-rings off cover and manifold. To give an excessive initial end play condition for input shaft, when installing the input shaft manifold use an oversize shim pack of 4.32 [mm]. For the output shaft manifold use an oversize shim pack of 5.72 [mm]. With input shaft manifold and output shaft manifold installed and inclusion of oversize shim packs under the flanges and retained by two opposite bolts, tightened to appropriate torque value for each shaft, a push/pull operation should be performed to insure that bearing cups and cones are seated in their desired locations.

Tools required for seating cones and cups are puller bridge and 5/8" ball bearing for seating output, input and countershaft bearings in pushing operation.

a. Directional Clutch (Refer to Fig. 7C.6).

1. Assemble an oversize shim pack of 4.32 [mm] from shims (12) and position on manifold (11). This will give an excess end float condition. Install directional shaft manifold (11) with oversize shim pack, being sure to align pilot dowel in manifold with slot in manifold. Do not install O-ring (13) at this time.

NOTE: Direction shaft assembly must have its bearing cones pressed solidly against its respective shoulder before end play (float) is adjusted.

2. With orifice plug still removed from direction shaft place a 90 [mm] diameter x 6.5 [mm] thick plate over end of directional shaft to act as a pusher plate. Place a 250 [mm] puller bridge across two aligning manifold mounting holes. Install the puller bridge as shown in Fig. 7C.52 utilizing the two selected manifold mounting bolt holes. Torque the pusher screw to 108 [Nm]. Then remove the puller bridge and pusher plate.
3. Thread a M12 bolt in end of directional shaft. Rotate and tap shaft down using a plastic mallet. Install manifold bolts. Install a dial indicator (1, Fig. 7C.53) and zero dial. With a lever (2) or hoist raise shaft noting vertical movement or end play (float) (Fig. 7C.53). Add or remove shims to achieve desired end play (float) 0.13 to 0.25 [mm]. Rotate and tap shaft down using a plastic mallet and recheck end play (float) setting. It is important when adjusting end play (float) that front directional shaft bearing cup be maintained in a position where it is always being pushed with manifold toward bearing cone when shims are removed to adjust end play (float). This is necessary because bearing cup shoulders on manifold. If it is determined that end play (float) adjustment falls below specification and extra shims need to be added, manifold must be pulled up, shims added, pulled back down with manifold mounting bolts.

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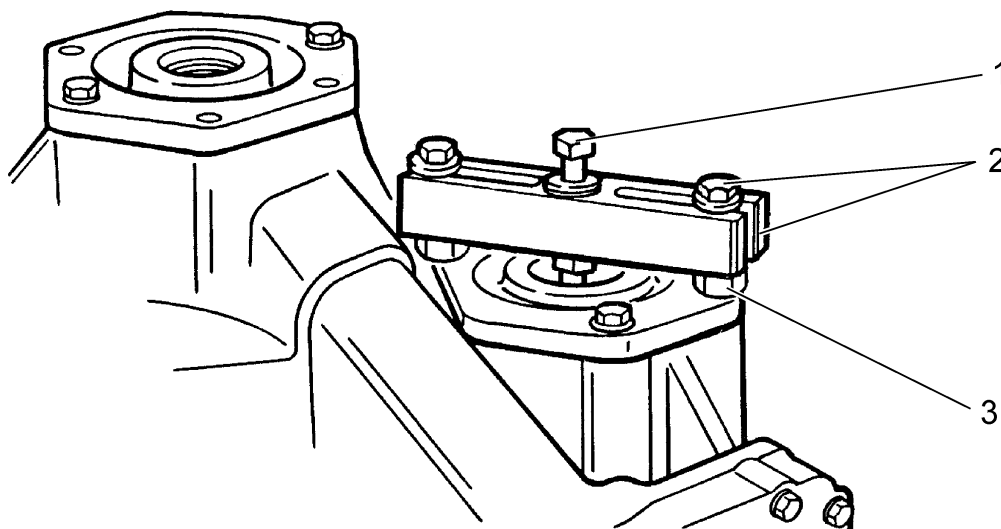


Fig. 7C.52. Directional Shaft Push Operation

1. Pusher Bridge with Pushscrew 2. Puller Bridge, Retainer Hardware 3. Spacers

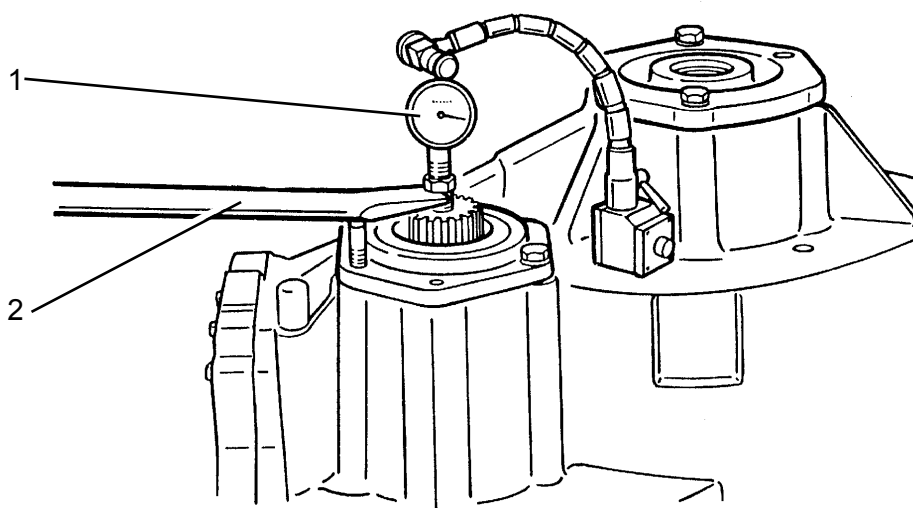


Fig. 7C.53. Checking Shaft End Float

1. Dial Indicator 2. Lever

4. After correct end play (float) has been established, install bearing manifold O-ring and retaining bolts and torque them $80 \pm 10\%$ [Nm]. Recheck end play (float) after manifold bolts are installed. Install transfer tubes (7) with new seals (8 and 9). Install yoke seal (10) in manifold (11) and lightly grease seal lips. Install orifice plug removed to adjust end float, roller trust race (2, Fig. 7C.28) and retaining ring (1, Fig. 7C.28). Install input yoke (39, Fig. 7C.7).

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b. Range Clutch (Refer to Fig. 7C.6).

5. Assemble an oversize shim pack of 5.72 [mm] from shims (33) and position on output shaft manifold (32). This will give an excess end float condition. Install range clutch shaft manifold (32) with oversize shim pack, being sure to align carrier over shaft without damaging previously installed seal rings. Do not install O-ring (34) at this time. Place a 90 [mm] diameter x 6.5 [mm] thick plate over end of directional shaft to act as a pusher plate. Place a 250 to 300 [mm] puller bridge across two aligning manifold mounting holes. Install puller bridge as shown in Fig. 7C.54, utilizing two selected manifold mounting bolt holes. Torque forcing screw to 217 [Nm]. Remove puller bridge.

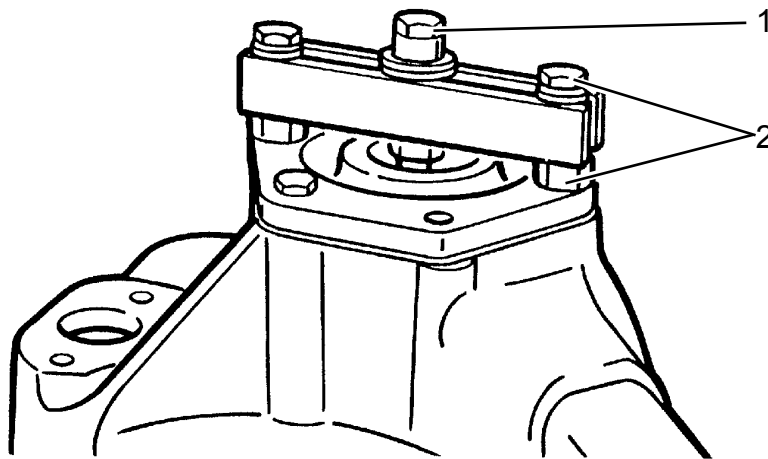


Fig. 7C.54. Output Shaft Push Operation

1. Puller Bridge with Push Screw

2. Retainer Hardware and Spacers

NOTE: Range shaft assembly must have its bearings pressed solidly against its respective shoulder before end play (float) is adjusted.

6. With an adjustable hook spanner wrench rotate and tap shaft down using a plastic mallet. Thread a M12 lifting eye or bolt in end of range shaft.



IMPORTANT! When threading lifting eye into range shaft do not damage inner plug behind threaded lifting plug. Install manifold bolts.

7. Install a dial indicator (1, Fig. 7C.55) and zero dial. Use lever (2) or hoist to raise shaft and check vertical end play (float). Add or remove shims to achieve desired end play 0.13 to 0.25 [mm]. Rotate and tap shaft down with a plastic mallet after removing or adding shims before rechecking end play (float). It is important when adjusting end play (float) that front range shaft cup in manifold be maintained in a position where it is always being pushed with manifold toward bearing cone, when ever shims are removed to adjust end play (float). If it is determined that end play adjustment falls below specification and extra shims need to be added, manifold must be pulled up, shims added, then pushed back down with mounting bolts.
8. After correct end play (float) has been established, install O-ring (34) on manifold. Install mounting bolts and torque to $80 \pm 10\%$ [Nm]. Recheck end play (float) after manifold bolts are installed. Install oil supply manifold four tubes (20 and 25) and plugs (18 and 23). Install race thrust (2, Fig. 7C.33) and retaining ring (1). Install O-ring (31, Fig. 7C.6) and cover plate (28).

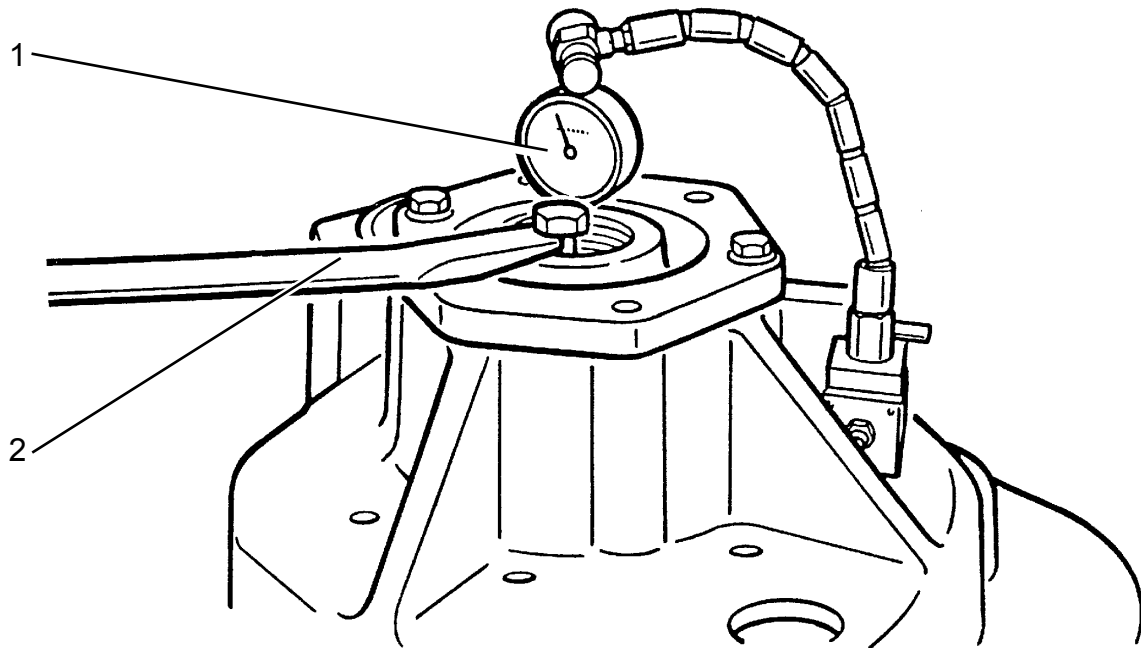
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Fig. 7C.55. Output Shaft End Play

1. Dial Indicator

2. Lever

c. Countershaft (Refer to Fig. 7C.6).

NOTE: Countershaft assembly must have a bearing push/pull operation performed to insure that bearing cups and cones are seated in their desired locations.

9. Assemble an oversize shim pack of 3.81 [mm] from shims (16) and position on countershaft retainer (14). This will give an excess end float condition. Place a 15.875 [mm] steel ball (17020R1) in machining pilot center on countershaft. Remove two pipe plugs (15) in retainer (14). Place a bridge across housing as shown in Fig. 7C.56. Do not install countershaft retainer (14) into its bore in transmission housing. Thread a bolt into puller bridge until it contacts steel ball. Torque pushing screw to 108 [Nm] to force shaft down. Remove puller bridge and steel ball. Install countershaft retainer (14) into its bore in transmission housing without O-ring (17).
10. Place a bridge across case and thread a M12 bolt through bridge, through cup retainer (14) and into end of shaft (Fig. 7C.57). Torque bolt to 108 [Nm] to seat bearing cone on countershaft. Remove bridge, but leave pulling bolt in position. Rotate and tap countershaft down using a plastic mallet. Install a dial indicator (Fig. 7C.58) and zero dial. With a lever or hoist raise shaft noting vertical movement of end play (float). Add or remove shims to achieve desired end play 0.13 to 0.25 [mm].
11. It is important when adjusting end play (float) that front countershaft bearing cup be maintained in a position where it is always being pushed with retainer toward bearing cone when shims are removed to adjust end play (float). After correct end play (float) has been established, install O-ring (17) on retainer (14). Recheck end play after shims and retainer is installed. Reinstall pipe plugs (15) in retainer (14). Torque retainer cap bolts to $80 \pm 10\%$ [Nm].

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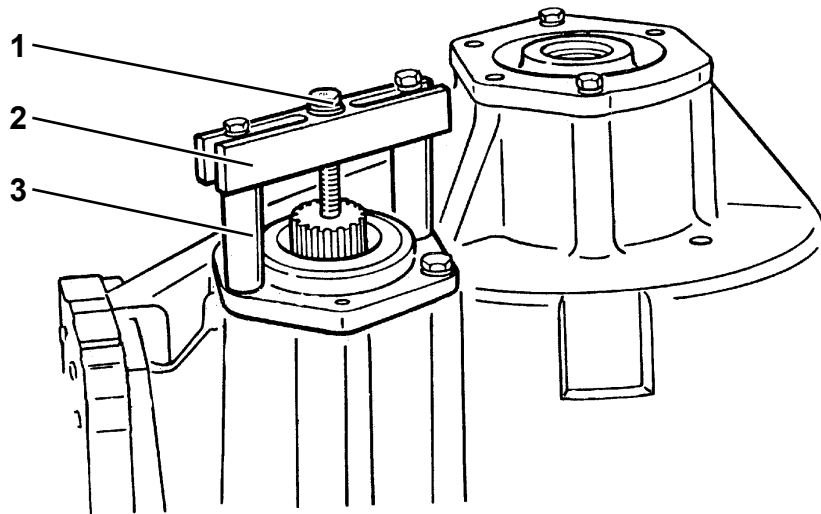


Fig. 7C.56. Push Operation

1. Pushing Screw and Washer 2. Puller Bridge and Retainer Bolts 3. Spacer

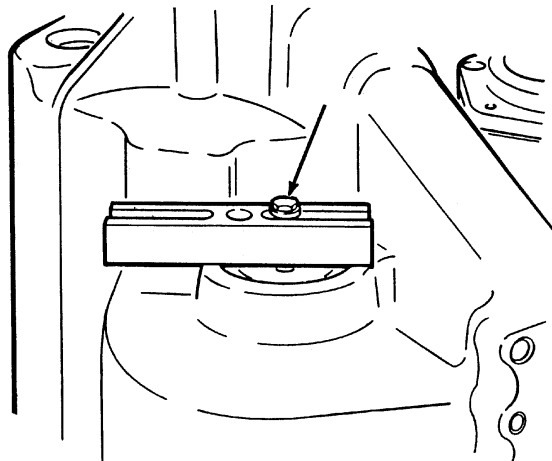


Fig. 7C.57. Pull Operation

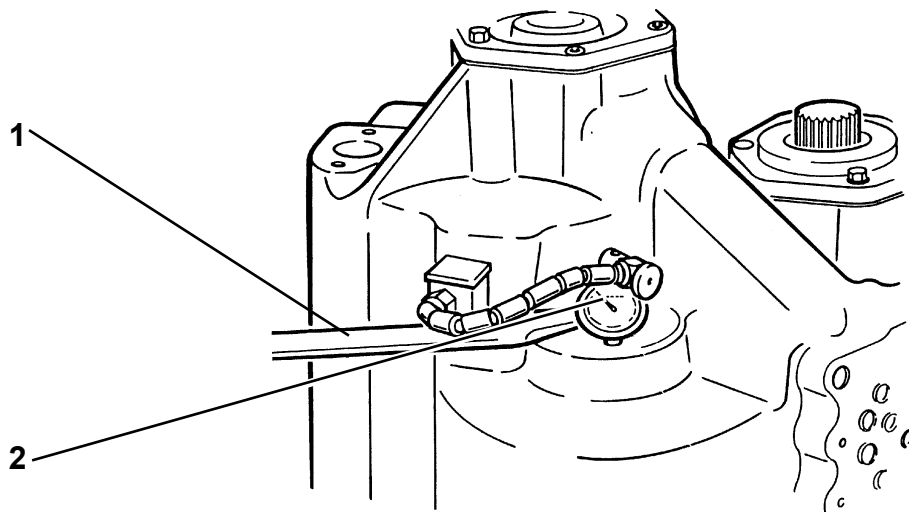


Fig. 7C.58. Checking End Play

1. Lever 2. Dial Indicator

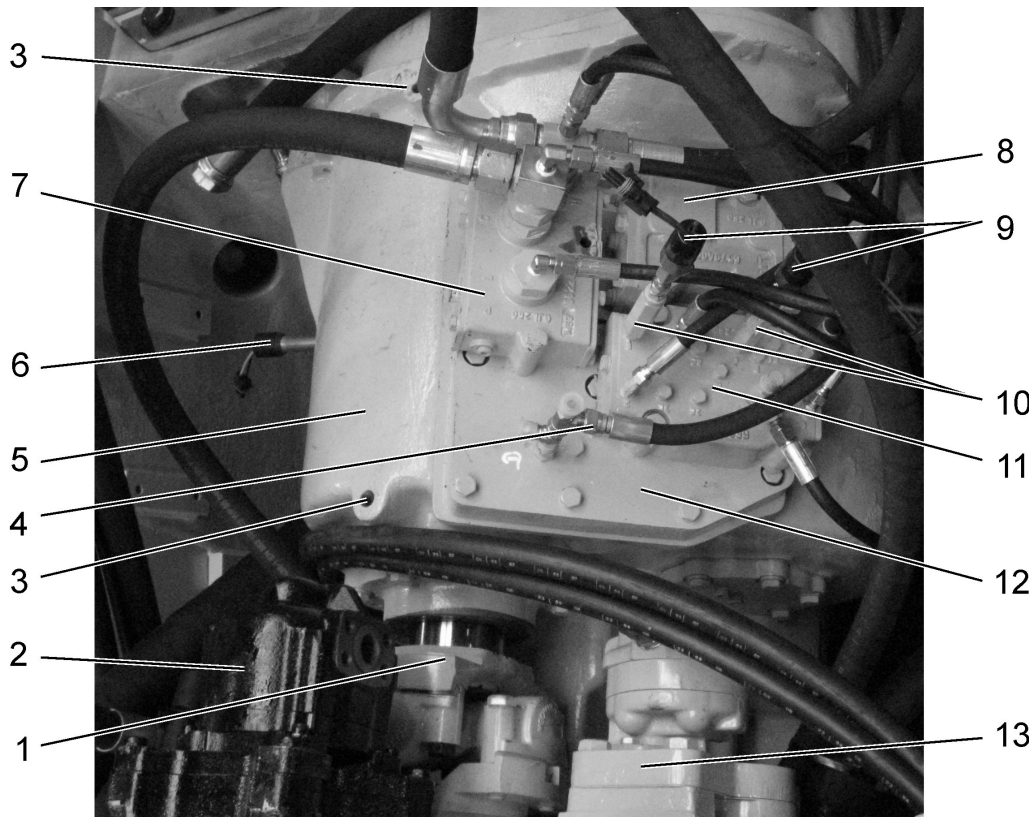
TRANSMISSION**8. INSTALLATION**

Fig. 7C.59. Transmission Reconnecting Points (Top View)

- | | | |
|--------------------|---------------------------------|-----------------------------|
| 1. Universal Joint | 6. Trans Input Shaft RPM Sensor | 11. Range Selector Valve |
| 2. Equipment Pump | 7. Pressure Regulator Valve | 12. Valves Manifold |
| 3. Eyebolt Hole | 8. Rate of Rise Valve | 13. Pilot and Scavenge Pump |
| 4. Drain Hose | 9. Pressure Switches | |
| 5. Transmission | 10. Check with Orifice Valves | |

1. Be sure the mating surfaces of the transmission manifold (12, Fig. 7C.59) and the housing are clean and free of any old gasket material. Install the manifold (12) with new gasket. Apply LOCTITE #262 to the bolts securing the manifold to the transmission. Torque the bolts to $46 \pm 10\%$ [Nm].
2. Be sure the mating surfaces of the rate of rise valve (1, Fig. 7C.59) and manifold (7) are clean and free of any old gasket material. Install the bolt with orifice strainer (3, Fig. 7C.1) into manifold channel. Install the rate of rise valve (8) with new gasket (9). Apply LOCTITE #262 to the bolts securing the valve to the manifold. Torque the bolts to $46 \pm 10\%$ [Nm].
4. Install yoke assy (39, Fig. 7C.7) on the directional input shaft (2).
5. Remove the covering from the rear main frame opening.
6. Position the transmission close to the machine and attach the hoist to two lifting eyes M16 (6, Fig. 7C.59). Install two new O-rings on rear of transmission cover. Raise the transmission, place it into position and move in back toward the main frame, being sure the output shaft splines with the steering drive pinion shaft sleeve. Secure the transmission to the main frame with the hardware previously removed (Fig. 7C.60). Torque the bolts to 760 [Nm].

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7. Remove the hoist and lifting eyes from the top of the transmission.

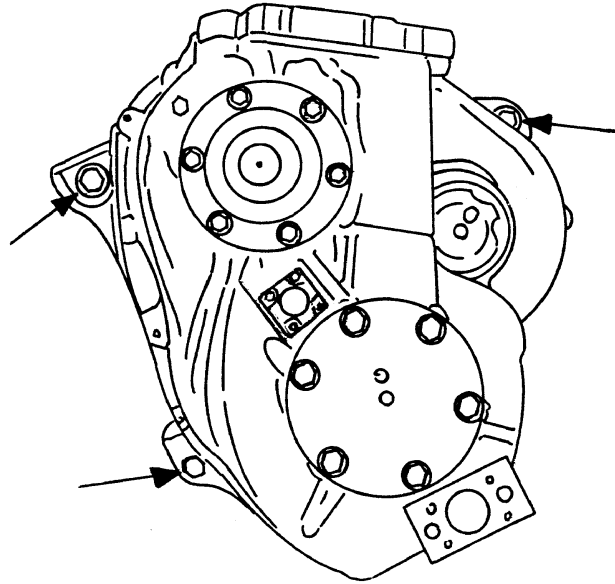


Fig. 7C.60. Securing the Transmission to the Rear Main Frame

8. Install the transmission universal joint (3, Fig. 7C.61) between the torque converter and transmission. Secure the universal joint to the drive yoke and to the torque converter output flange. Torque the bolts to $270 \pm 7\%$ [Nm].



CAUTION! Remove the wire used to keep the bearings from falling from the spider trunnions. If installing a new spider bearing assembly, remove the soft iron strap attached to the bearing cups. This will eliminate the possibility of the straps or wire breaking loose from the cups and causing personal injury when the engine is running.

9. Install the scavenge and pilot pump (5, Fig. 7C.61) on the torque converter. Refer to SECTION 10A, PUMPS for this procedure.
10. Reconnect lube hose (6) to the transmission (1).
11. Install the strainer (2, Fig. 7C.63) to the transmission (1).
12. Reconnect scavenge suction hose (7, Fig. 7C.61) to the transmission (1).
13. Reconnect the torque converter breather hose (2).
14. Be sure the mating surfaces of the range selector valve (11, Fig. 7C.59), pressure regulator valve (7) and transmission manifold (12) are clean. Reinstall the valves (with hoses still attached) with new O-rings (6 and 7, Fig. 7C.1) on the transmission manifold. Apply LOCTITE #262 to bolts securing the valves to the manifold. Torque the bolts to $46 \pm 10\%$ [Nm].
15. Reconnect inlet and outlet main pressure hoses with tee to main port (M) of pressure regulator valve (7, Fig. 7C.59). Reconnect outlet hose to converter pressure port (C) of pressure regulator valve (7).

TRANSMISSION

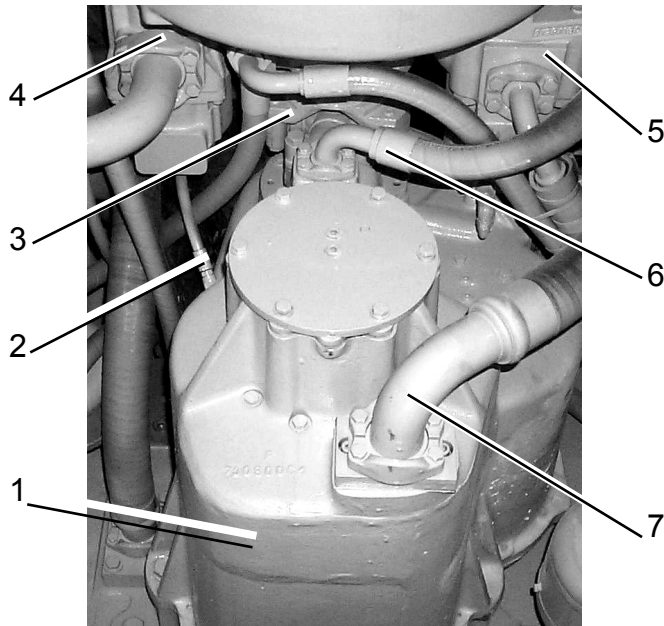


Fig. 7C.61. Transmission Connecting Points (Bottom View)



Fig. 7C.62. Installing Equipment Pump

- | | |
|---------------------------|----------------------------|
| 1. Transmission | 5. Scavenge and Pilot Pump |
| 2. Breather Hose | 6. Lube Hose |
| 3. Universal Joint | 7. Scavenge Suction Hose |
| 4. Charge and Cooler Pump | |

16. Reconnect gear shifting valve hoses (1 and 2 pressure ports), switching valve hose (Pc pressure port) and brake solenoid valve hose (N pressure port) to range selector valve (2, Fig. 7C.59).

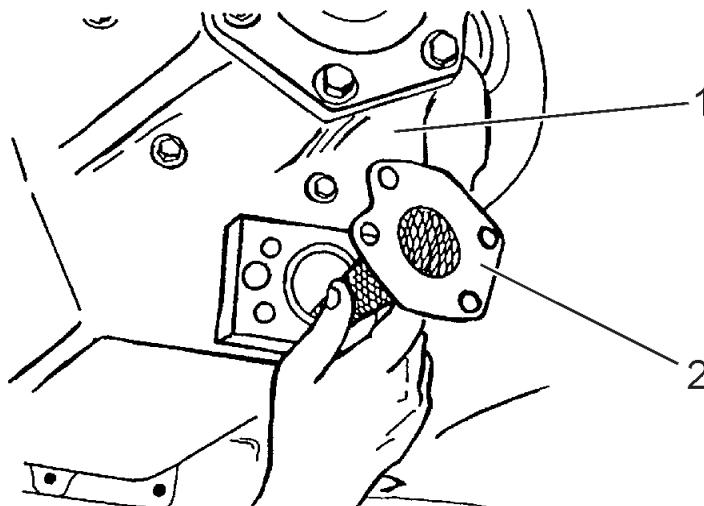


Fig. 7C.63. Scavenge Pump Strainer

- | | |
|-----------------|-------------|
| 1. Transmission | 2. Strainer |
|-----------------|-------------|

TRANSMISSION

TRANSMISSION

17. Reconnect drain hoses (4, Fig. 7C.59) to the valve manifold (12).
18. Apply LOCTITE #592 to thread RPM sensor (6) and install it into the transmission housing (5). Carefully screw the sensor (6) in as far as it will go and until it just touches input shaft drum. Undo the sensor 1 3/4 turns and lock it with a lock nut.
19. If removed, install check with orifice valves (10) to the range selector valve (11). Install FWD and RWD travel pressure switches (9). Reconnect the electrical harness wires to the travel pressure switches (9) and RPM sensor (6).
20. Reconnect two outlet hoses from the charge and cooler pump (4, Fig. 7C.61)
21. Install the equipment pump (Fig. 7C.62) on the torque converter. Refer to SECTION 10A for this procedure.
22. Install the ROPS, cab and platform, refer to SECTION 13, SUPERSTRUCTURE.
23. Refill the main frame and hydraulic reservoir as described in the OPERATOR'S MANUAL. Start the engine. Check for leakage. If the main and range clutch oil warning lamp is lighting, make inspection and repair.
24. Check the oil pressures in the transmission as described in TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST, under SERVICE DIAGNOSIS in SECTION 7.
25. Install the front center floor plate and the transmission case guard.
26. Check the rear frame oil level and add if necessary.
27. After first 10 hours of operation disassemble and clean the suction filter. Change the pressure filters.

PRESSURE REGULATOR VALVE

9. DESCRIPTION (Refer to Fig. 7C.64 and 7C.65)

This valve is a cascade type, pressure control valve consisting of three individual valves encased in one housing. The first valve is used to control pressure for the engagement of the clutches in the transmission and the steering drive. The second valve is used to control pressure in the converter. The third valve is used to control lube pressure in the transmission. A cold oil relief valve is included in the first valve.

Theory of operation

Oil from the pump enters the valve at cavity M. This oil is then directed to the other control valves and on to the transmission and steering drive to operate the clutch packs. As pump flow continues, pressure builds and oil is forced through the center of spool (13), causing it to move against the outer and inner springs (5 and 7). When the pressure reaches M, the first valve opens and allows oil to enter cavity C. The main spool also contains a cold oil relief valve. When the oil is cold, pressure can exceed M value. When this happens, the check ball (11) is forced against the spring (10) and excessive pressure is relieved and valve chatter is prevented.

Oil from cavity M enters cavity C and is directed on to the converter. When flow is met, pressure builds and oil is forced through the center of the spool (6) causing the spool to move against the spring (4). When pressure reaches C, the second valve opens and allows oil to enter cavity L. Return oil from the oil cooler and excessive oil from cavity C enters cavity L and is then directed to the transmission for lube. Whenever this lube oil reaches L, the third valve opens and dumps the oil to drain.

TRANSMISSION

PRESSURE REGULATOR VALVE

10. REMOVAL AND DISASSEMBLY (Refer to Fig. 7C.64 and 7C.65)



WARNING! Before working on a machine, be sure that the blade and ripper have been lowered to the ground, the engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and controls are tagged to prevent inadvertent engine starting.

IMPORTANT: When disconnecting hydraulic lines for any reason, they should be properly capped with the correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt or lint into critical hydraulic components of the machine. Tag all disconnected oil lines to facilitate easier installation.

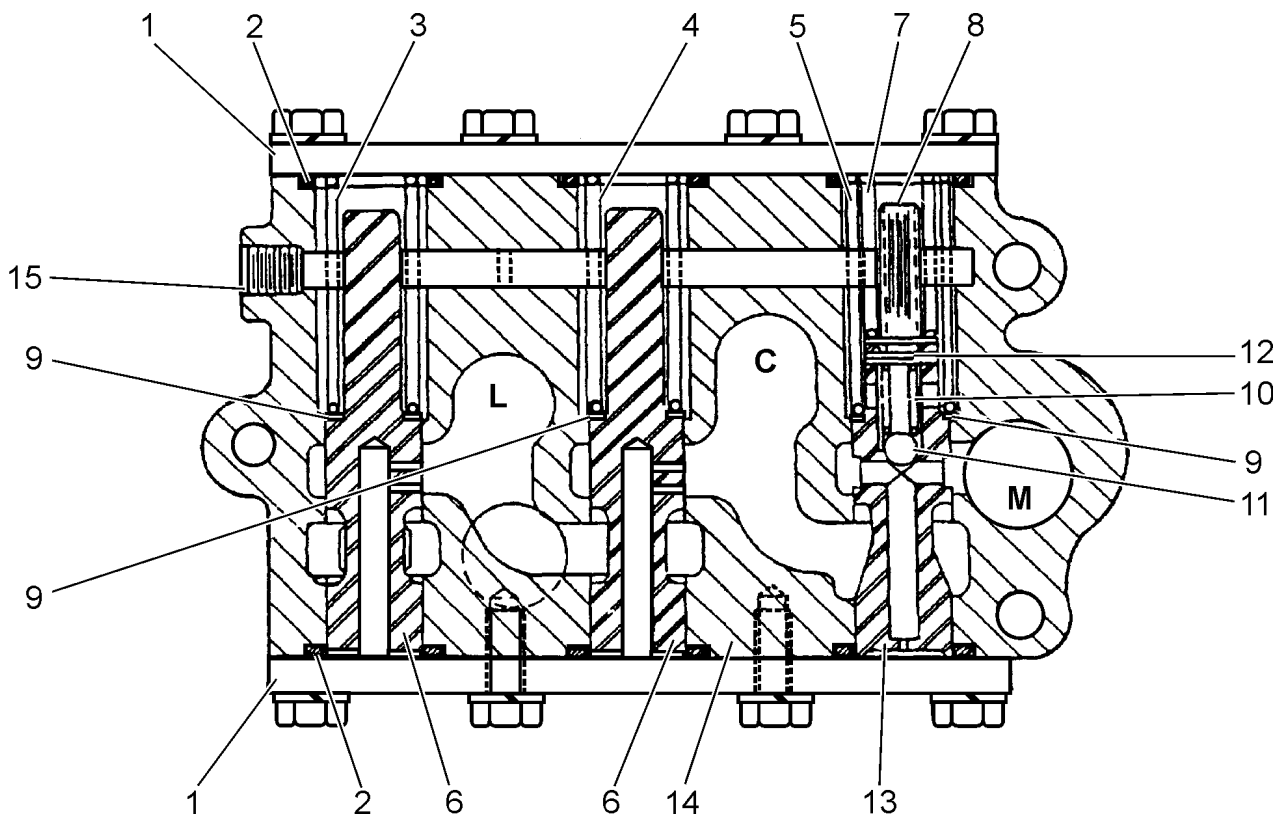
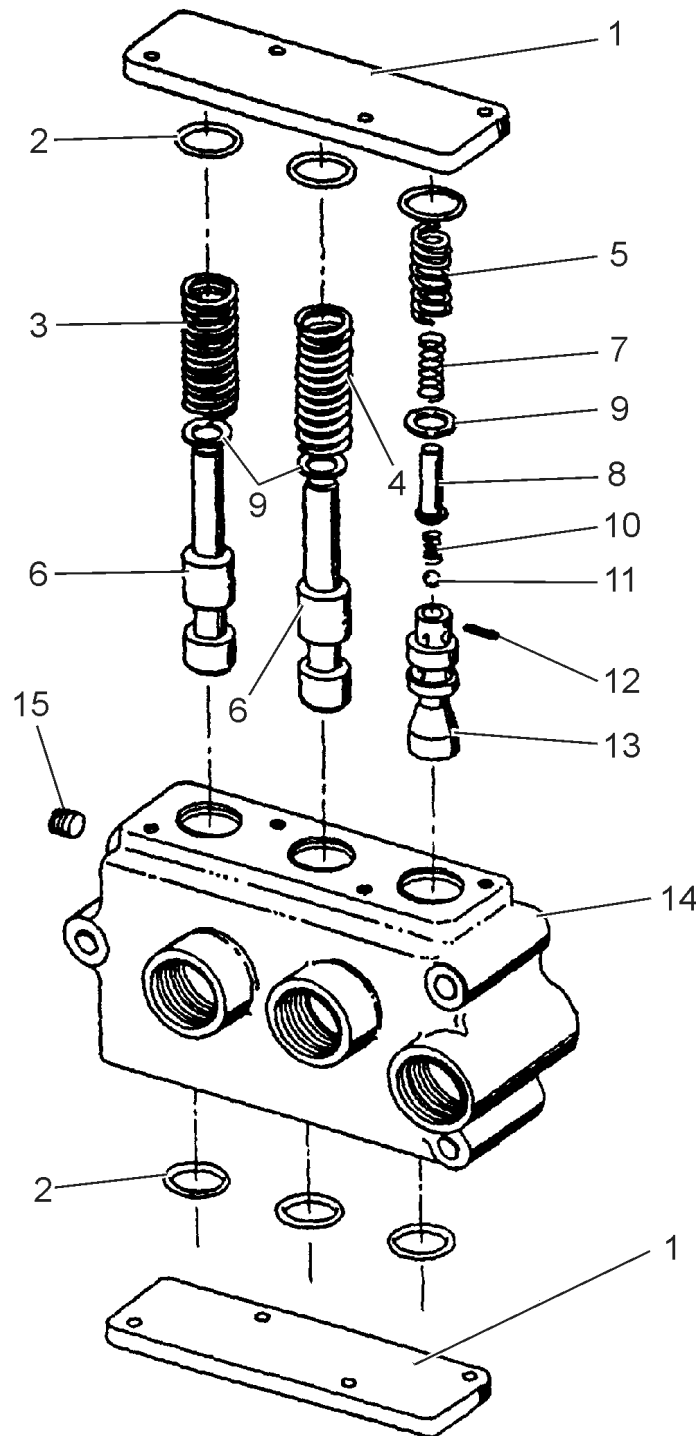


Fig. 7C.64. Cross Section of Pressure Regulator Valve

- | | |
|-----------------------------------|-------------------|
| 1. End Cover | 9. Shim |
| 2. O-Ring | 10. Ball Spring |
| 3. Lube Spool Spring | 11. Check Ball |
| 4. Torque Converter Spool Spring | 12. Spring Pin |
| 5. Main Spool Outer Spring | 13. Main Spool |
| 6. Lube or Torque Converter Spool | 14. Valve Housing |
| 7. Main Spool Inner Spring | 15. Port Plug |
| 8. Spring Guide Pin | |



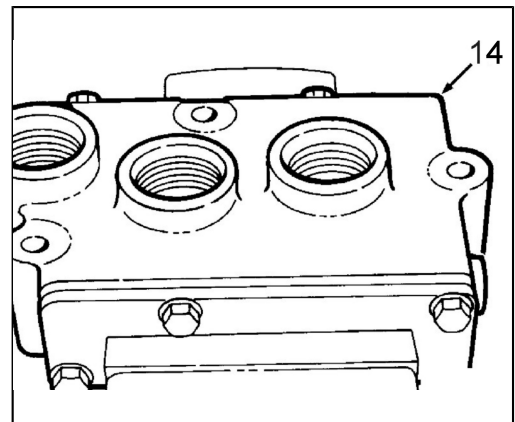
- | | | |
|----------------------------------|-----------------------------------|-------------------|
| 1. End Cover | 6. Lube or Torque Converter Spool | 11. Check Ball |
| 2. O-Ring | 7. Main Spool Inner Spring | 12. Spring Pin |
| 3. Lube Spool Spring | 8. Spring Guide Pin | 13. Main Spool |
| 4. Torque Converter Spool Spring | 9. Shim | 14. Valve Housing |
| 5. Main Spool Outer Spring | 10. Ball Spring | 15. Port Plug |

TRANSMISSION

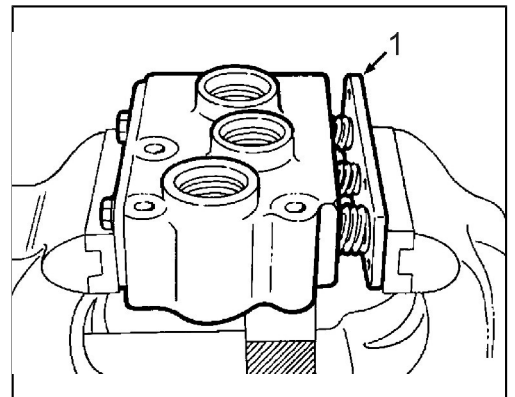
PRESSURE REGULATOR VALVE

1. Remove floor mat (cab equipped machines). Remove the bolts securing the center floor plate between seat and instrument panel and remove the plate.
2. Disconnect the hoses at pressure regulator valve and tag them.
3. Remove the bolts and washers securing the valve to top of the transmission manifold. Remove the valve assembly and mounting O-rings.

4. Position the valve housing (14) into a vise, supporting the valve as necessary.

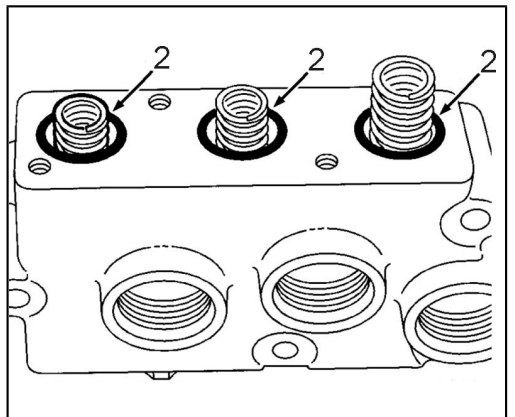


5. Remove the bolts and lock washers from the end cover (1). Slowly back off vise allowing springs to decompress.



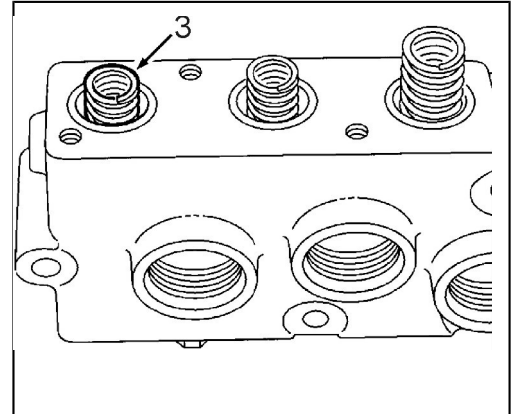
WARNING! Spring loaded assembly. Covers must be held to relieve spring pressure. Use extreme care when disassembling.

6. Remove the O-rings (2) from the valve housing and discard.



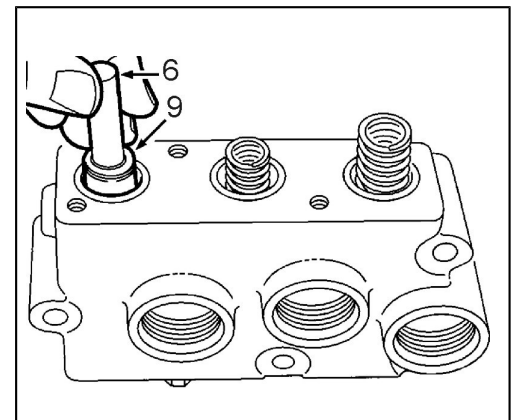
PRESSURE REGULATOR VALVE

7. Remove the lube spool spring (3). Identify the spring for ease of testing and assembly.

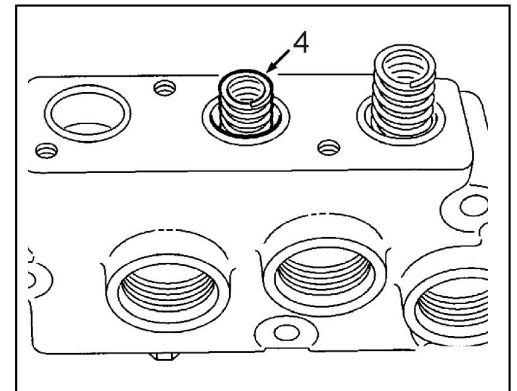


8. Remove the lube spool (6) with the spring shims (9). Keep the removed amount of shims with the spool.

NOTE: Both the lube and converter spools (6) are interchangeable. Do not switch the spools in each others housing bore.

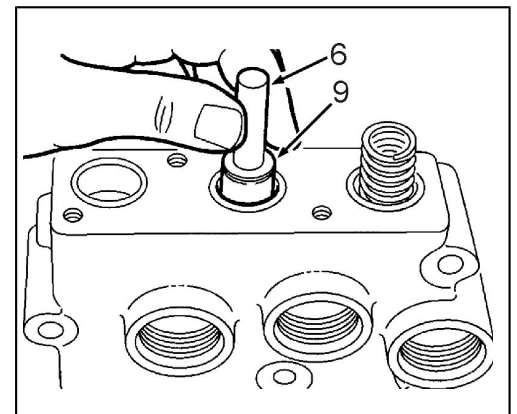


9. Remove the converter spool spring (4). Identify the spring for ease of testing and assembly.



10. Remove the converter spool (6) with the spring shims (9). Keep the removed amount of shims with the spool.

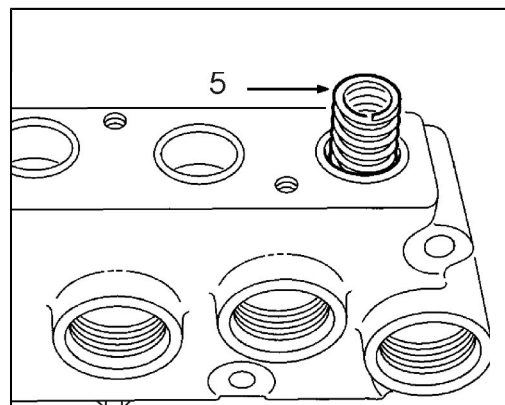
NOTE: Both the lube and converter spools (6) are interchangeable. Do not switch the spools in each others housing bore.



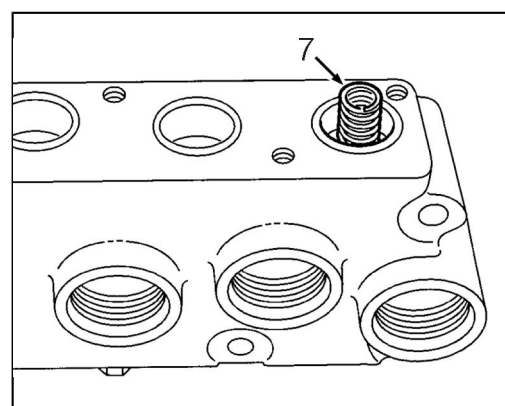
TRANSMISSION

PRESSURE REGULATOR VALVE

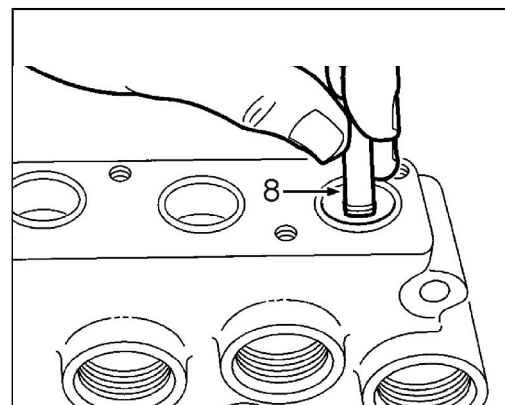
11. Remove the main spool outer spring (5). Identify the spring for ease of testing and assembly.



12. Remove the main spool inner spring (7). Identify the spring for ease of testing and assembly.



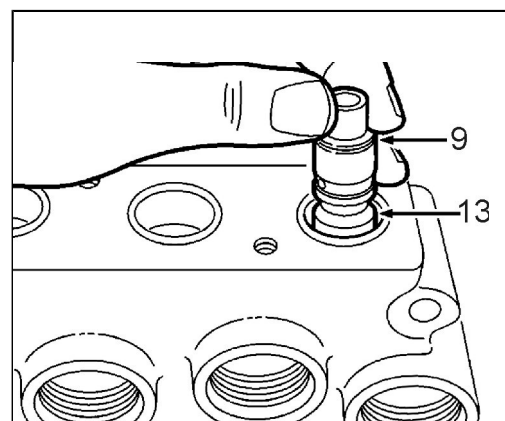
13. Remove the spring guide pin (8).



14. Remove the main spool assembly (13) with the spring shims (9). Keep the removed amount of shims with the spool.

15. Remove the remaining end cover (1) and discard the O-rings (2).

16. If necessary, remove port plug (15) from the valve housing (14).



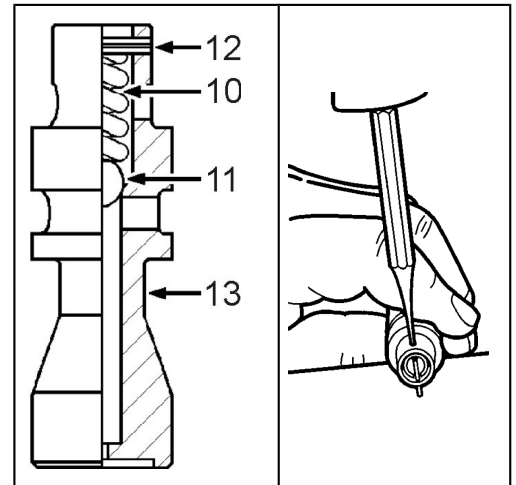
PRESSURE REGULATOR VALVE

17. If necessary, disassemble the main spool as follows;

Rest the assembly on a block of wood. Using a pin drift, drive the spring pin (12) from the spool (13) allowing the pin drift to retain the spring (10). Carefully remove the pin drift allowing the check ball spring to decompress. Remove the spring and check ball (11).



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.



11. INSPECTION AND REPAIR

1. It is recommended that all new O-rings be installed upon reassembly of the valve.
2. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all oil passages in the valve housing and spools are clean and free of obstructions.
3. Inspect the parts for excessive wear and replace if necessary.
4. Inspect the condition of the springs. If they are damaged or do not fall within the specifications shown in SPECIFICATIONS, under TRANSMISSION in this Section, they must be replaced.

TRANSMISSION

PRESSURE REGULATOR VALVE

12. REASSEMBLY AND INSTALLATION (Refer to Fig. 7C.64 and 7C.65)

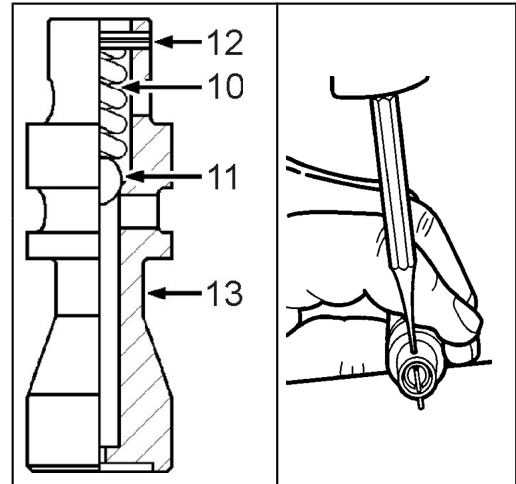
NOTE: Lubricate the spools and valve bores with transmission oil upon reassembly.

NOTE: Be sure springs are assembled in the correct bore of the valve and the same amount of shims are installed as were removed from each bore.

1. Reassemble the main spool as follows;
Install the check ball (11) and the check ball spring (10) into the spool (13). Compress the spring and secure with the spring pin (12).

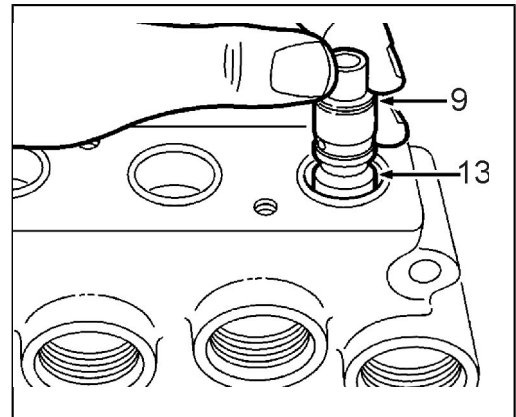


WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when assembling.

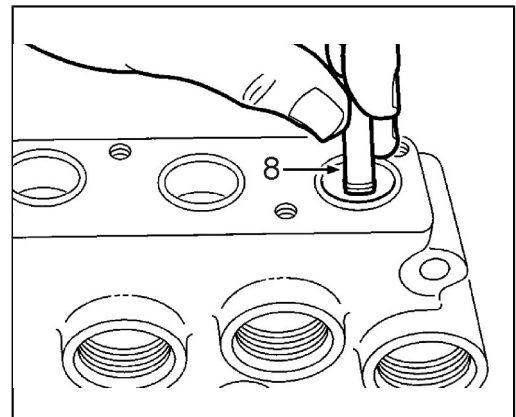


2. Apply LOCTITE Pipe Sealant #569 to plug (15) and install in the valve housing (14) if removed.
3. Install new O-rings (2) into the bottom of the housing and bolt the bottom end cover (1) in place.
4. Install the main spool assembly (13) with the same amount of shims (9) that were removed.

NOTE: A total quantity of 3 shims can be used under the spool spring. Each shim that is added or removed will raise or lower the main pressure by 35 [kPa].

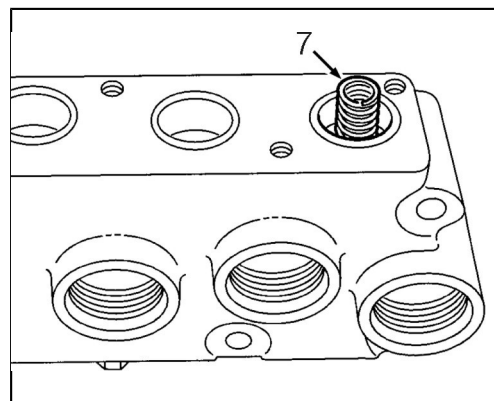


5. Install the spring guide pin (8) in the housing bore.

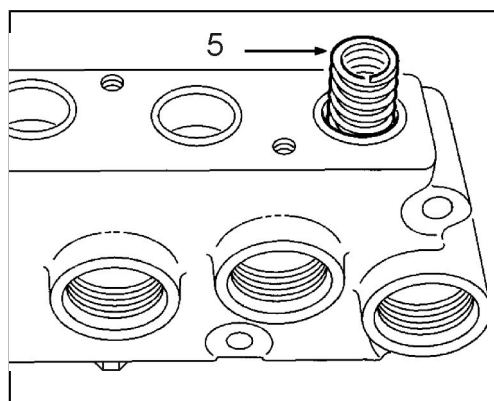


PRESSURE REGULATOR VALVE

6. Install the main spool inner spring (7).



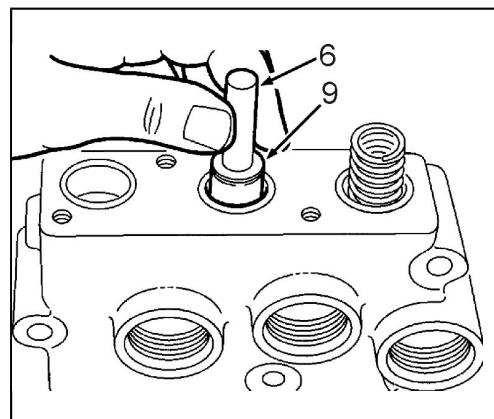
7. Install the main spool outer spring (5).



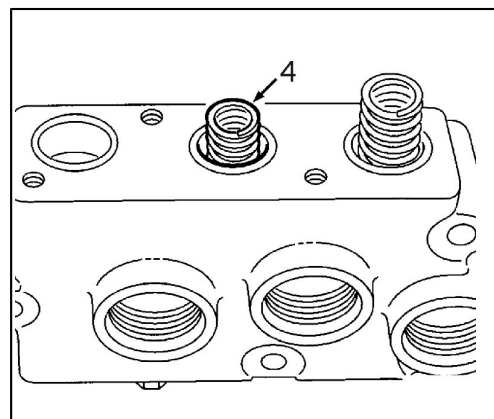
8. Install the converter spool (6) with the spring shims (9) that were removed with the spool.

NOTE: A total quantity of 3 shims can be used under the spool spring. Each shim that is added or removed will raise or lower the converter pressure by 25 [kPa].

NOTE: Both the lube and converter spools (6) are interchangeable. Do not switch the spools in each other's housing bore.



9. Install the converter spool spring (4).



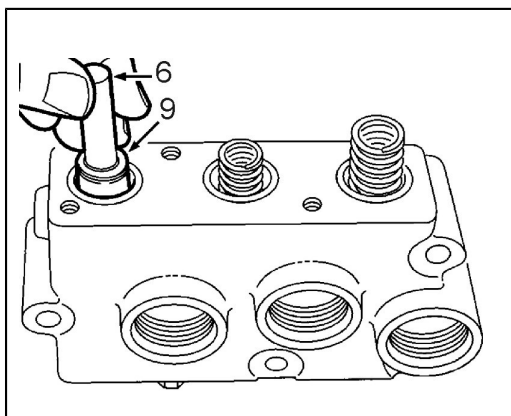
TRANSMISSION

PRESSURE REGULATOR VALVE

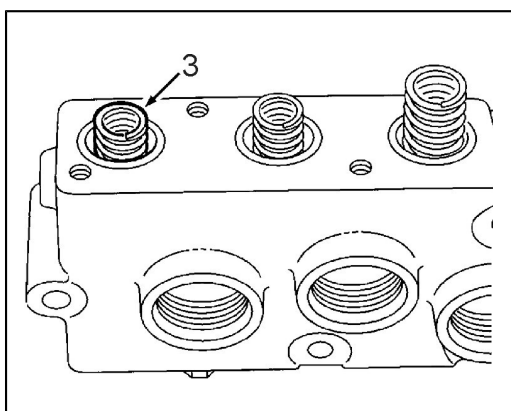
10. Install the lube spool (6) with the spring shims (9) that were removed with the spool.

NOTE: A total quantity of 3 shims can be used under the spool spring. Each shim that is added or removed will raise or lower the lube pressure by 7 [kPa].

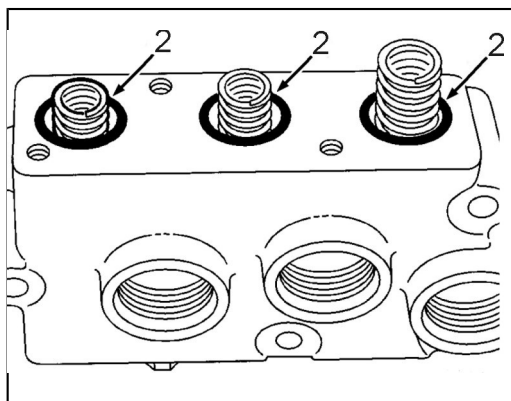
NOTE: Both the lube and converter spools (6) are interchangeable. Do not switch the spools in each other's housing bore.



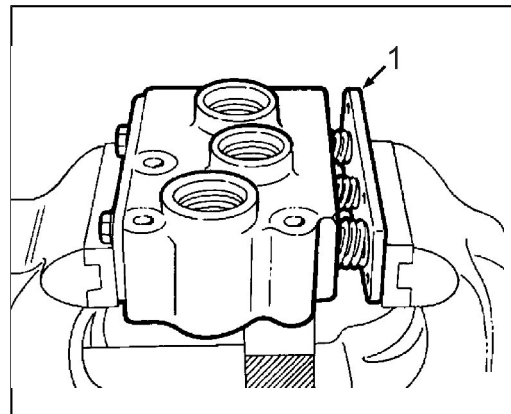
11. Install the lube spool spring (3).



12. Install the new O-rings (2) into the housing grooves.



13. Position the valve housing and the top end cover (2) in the vise.

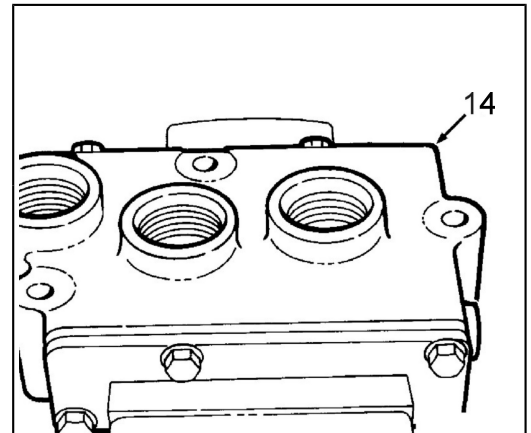


PRESSURE REGULATOR VALVE

14. Slowly close the vise and install the mounting hardware to the cover (1). Tighten the bolts securing both covers (1) to a torque 26 - 28 [Nm].



WARNING! Spring loaded assembly. Covers must be held to relieve spring pressure. Use extreme care when assembling.



15. Position the valve and O-rings on top of the transmission housing and secure with bolts and washers. Torque the bolts to 42 - 50 [Nm].
16. Reconnect the hoses at the pressure regulator valve.
17. Check the oil level in the main frame as described in the OPERATOR'S MANUAL.

IMPORTANT! As soon as the engine starts, observe the transmission main and range clutch oil pressure warning lamp on the dash. If lights, immediately turn off engine.

18. Start the engine. Check for leaks. Check oil pressures as described in TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST, under SERVICE DIAGNOSIS in SECTION 7.
19. Install the center floor plate between seat and instrument panel. Install the floor mat, if cab equipped.
20. Check oil level in rear main frame as described in OPERATOR'S MANUAL.

TRANSMISSION

RANGE SELECTOR VALVE

13. DESCRIPTION (Refer to Fig. 7C.66 and 7C.67)

Range selector valve is a hydraulically controlled, directional control valve consisting of two range spools (5), one switch spool (4) and one directional spool (8). Range spools are separated in valve housing by a return spring (3). Directional and switch spools are held together at one side by their return spring (3). Function of range selector valve is to provide main pressure oil to rate of rise valve and return oil from rate of rise valve to desired clutch packs. Valve is hydraulically and electronically controlled by drive train control valve.

Theory of operation

Short directional switch spool (4) controls flow of oil to rate of rise valve. When in neutral, return spring (3) holds this spool (4) against long directional selector spool (8), thereby cutting off flow of oil. When drive train control lever is placed in forward, main pressure oil from drive train control valve enters port F and shifts spool (4) against return spring (3). When control lever is placed in reverse, main pressure oil from drive train control valve enters port R and shifts both spools (4 and 8) against return spring (3).

Once short switch spool (4) is shifted over, port P1 is open to port P, directing oil to rate of rise valve. Long directional selector spool (8) controls flow of oil to forward and reverse clutch packs. When control lever is in forward, oil from rate of rise valve enters port FR, and is directed out port FC to engage forward clutch shaft. When control lever is placed in reverse, main pressure oil enters port R, shifts spool (8) and port FR is opened to port RC to engage reverse clutch pack. Two range selector (speed) spools (5) control flow of oil to speed clutch packs. When first speed is selected, main pressure oil from gear shifting valve enters port 1, shifting spool (5) against return spring (3). When in this position, oil from rate of rise valve enters port PC and is directed out port 1C to engage first speed clutch pack. When second speed is selected, oil enters port 2 to shift spool (5) and port PC is opened to port 2C to engage second speed clutch pack. When third speed is selected, return spring (3) holds spools (5) in place and port PC is opened to port 3C to engage third speed clutch pack.

RANGE SELECTOR VALVE**14. REMOVAL AND DISASSEMBLY (Refer to Fig. 7C.66 and 7C.67)**

WARNING! Before working on a machine, be sure that the blade and ripper have been lowered to the ground, the engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and controls are tagged to prevent inadvertent engine starting.

IMPORTANT: When disconnecting hydraulic lines for any reason, they should be properly capped with the correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt or lint into critical hydraulic components of the machine. Tag all disconnected oil lines to facilitate easier installation.

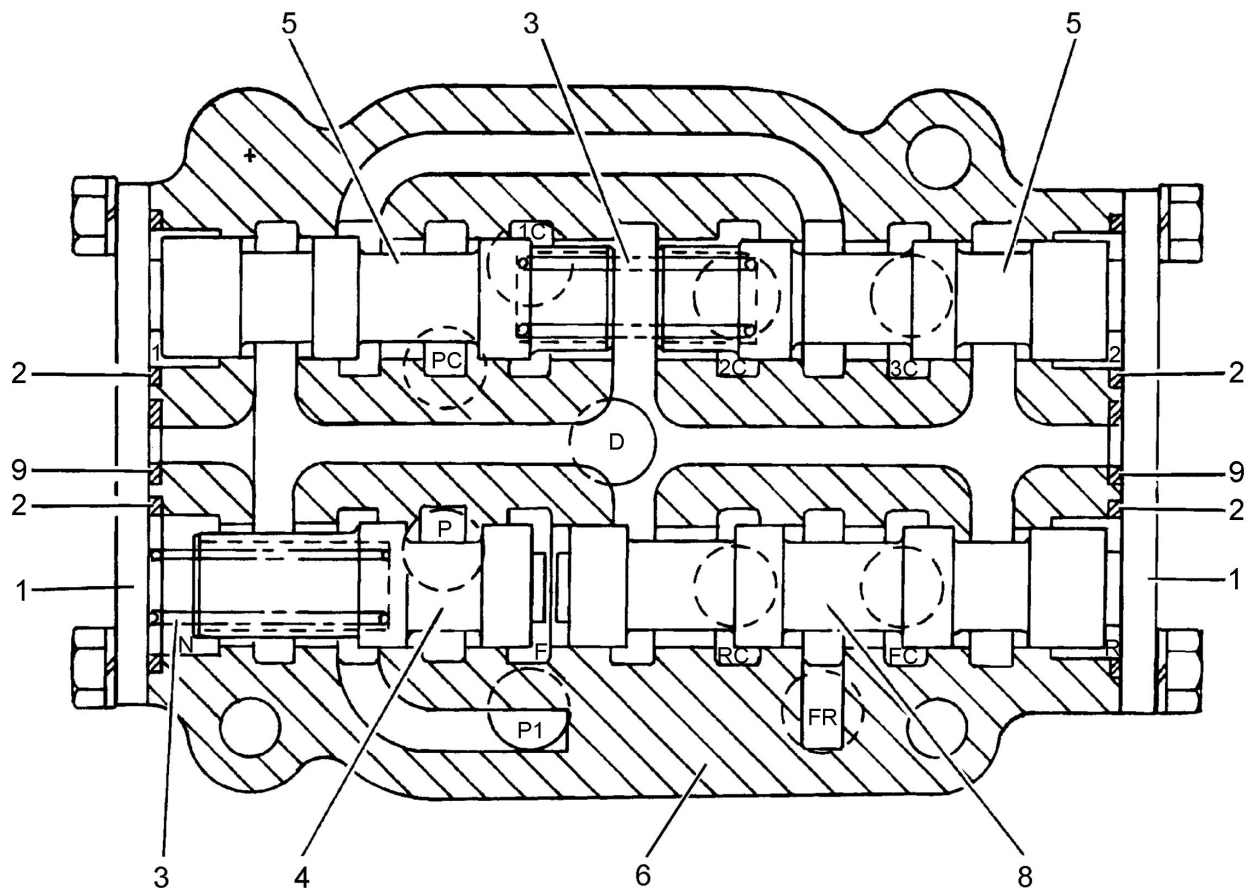


Fig. 7C.66. Cross Section of Range Selector Valve

1. End Cover
2. O-Ring
3. Return Spring
4. Switch Spool
5. Range Selector Spool
6. Valve Housing
8. Directional Spool
9. O-Ring

TRANSMISSION

RANGE SELECTOR VALVE

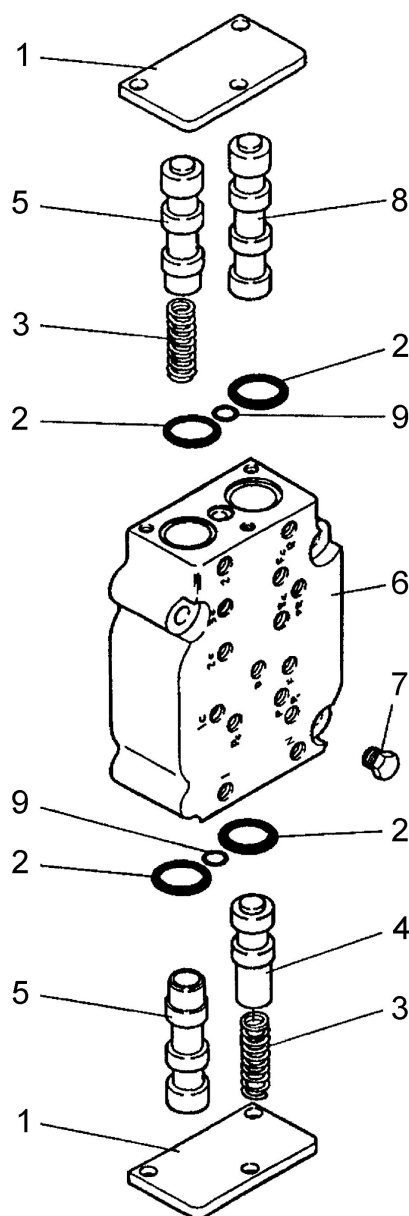


Fig. 7C.67. Exploded View of Range Selector Valve

- | | | |
|------------------|-------------------------|-------------------------------|
| 1. End Cover | 4. Switch Spool | 7. Port Plug |
| 2. O-Ring | 5. Range Selector Spool | 8. Directional Selector Spool |
| 3. Return Spring | 6. Valve Housing | 9. O-Ring |

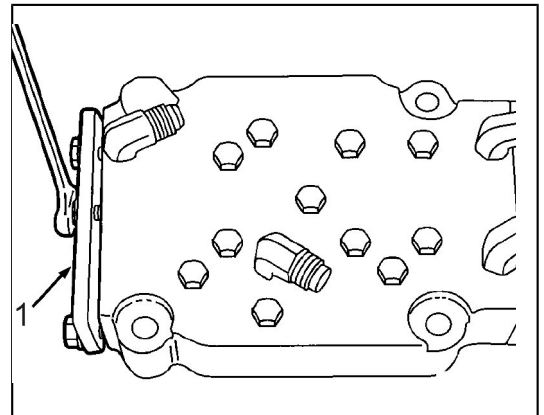
1. Remove floor mat (cab equipped machines). Remove the bolts securing the center floor plate between seat and instrument panel and remove the plate.
2. Disconnect the hoses at range selector valve and tag them.
3. Remove the bolts and washers securing the valve assembly to the top of the transmission housing. Remove the valve assembly and mounting O-rings.

RANGE SELECTOR VALVE

4. Slowly loosen the end cover (1) bolts until all the spring tension is relieved. Remove the end cover.

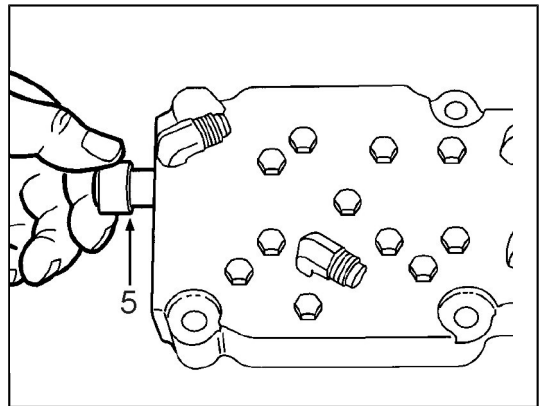


WARNING! Spring loaded assembly. Covers must be held to relieve spring pressure. Use extreme care when disassembling.

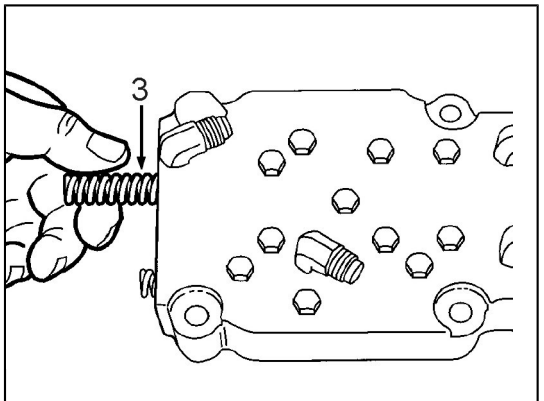


5. Remove the range selector spool (5) from the housing.

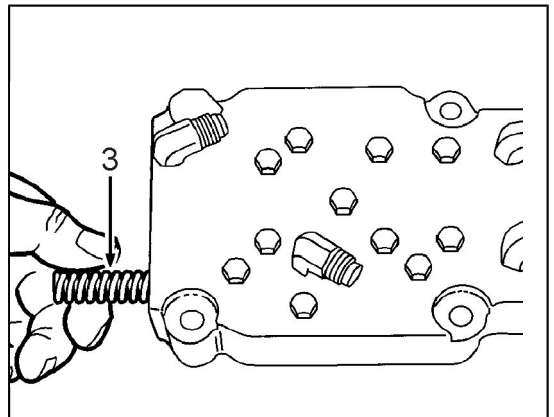
NOTE: The spool is to be kept with the housing bore side that it was removed from.



6. Remove the range spool return spring (3) from the housing bore.



7. Remove the switch spool return spring (3) from the housing bore.

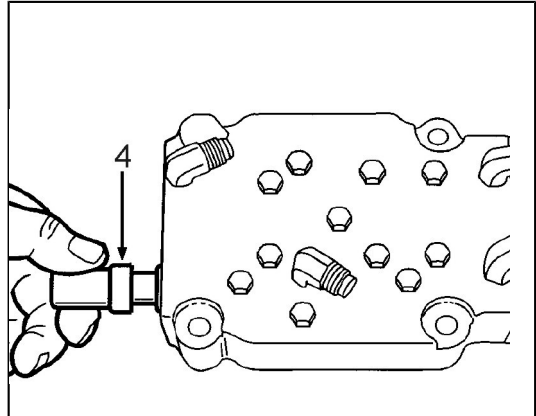


TRANSMISSION

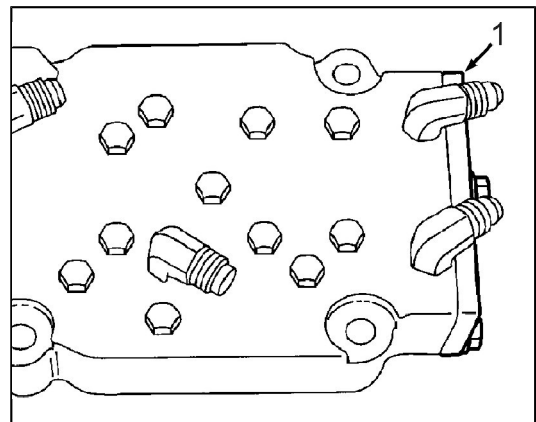
RANGE SELECTOR VALVE

8. Remove the switch spool (4) from the housing bore.

NOTE: The spool is to be kept with the housing bore side that it was removed from.

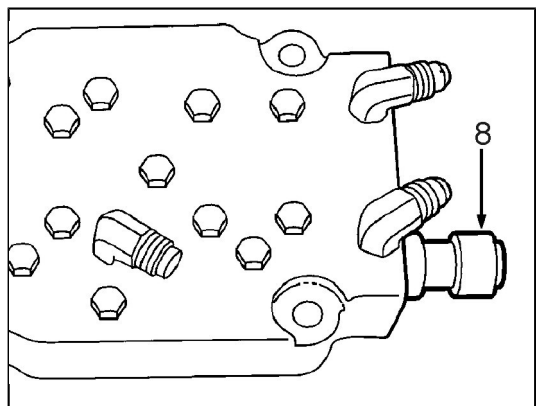


9. Remove the remaining end cover (1).



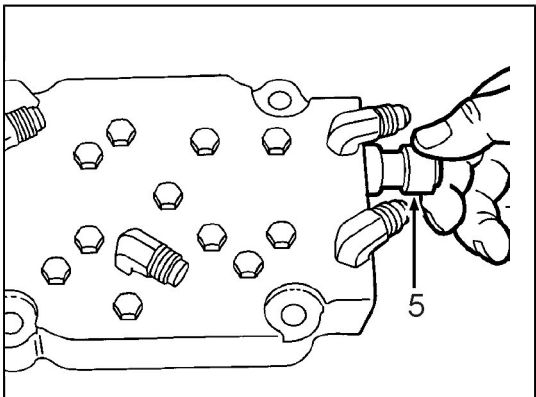
10. Remove the directional selector spool (8) from the housing.

NOTE: The spool is to be kept with the housing bore side that it was removed from.



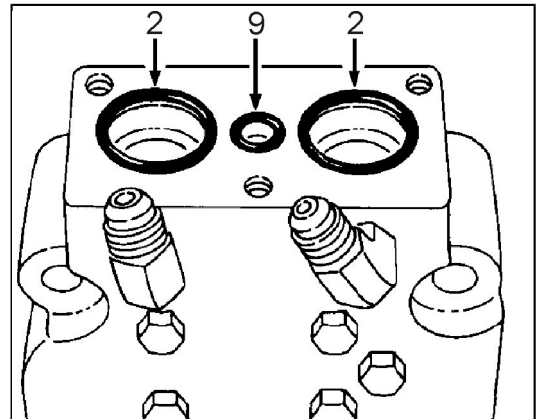
11. Remove the remaining range selector spool (5) from housing bore.

NOTE: The spool is to be kept with the housing bore side that it was removed from.



RANGE SELECTOR VALVE

12. Remove the large (2) and small (9) O-rings from each end of the housing. Discard the O-rings and replace with new.



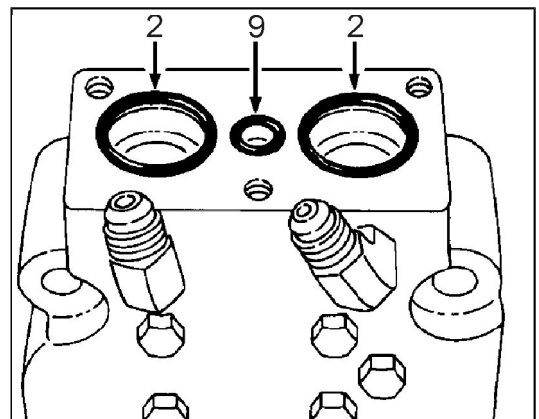
15. INSPECTION AND REPAIR

1. It is recommended that all new O-rings be installed upon reassembly of the valve.
2. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all the oil passages in the valve housing are clean and free of obstructions.
3. Inspect the parts for excessive wear and replace if necessary.
4. Inspect the condition of the springs. If they are damaged or do not fall within the specifications shown in SPECIFICATIONS, under TRANSMISSIONS in this Section, they must be replaced.

16. REASSEMBLY AND INSTALLATION (Refer to Fig. 7C.66 and 7C.67)

NOTE: *Lubricate the spools and valve bores with transmission oil upon reassembly.*

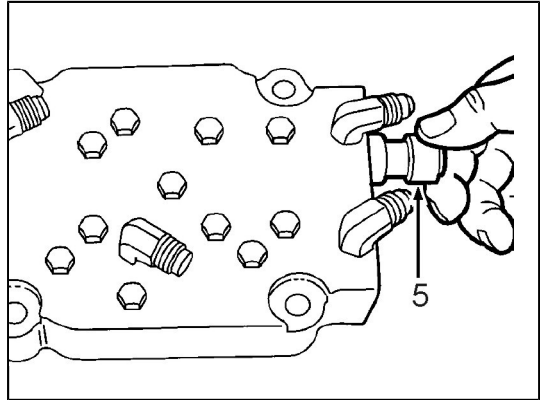
1. Coat the new large (2) and small (9) O-rings with amber grease and install in the counter bores in each end of the housing.



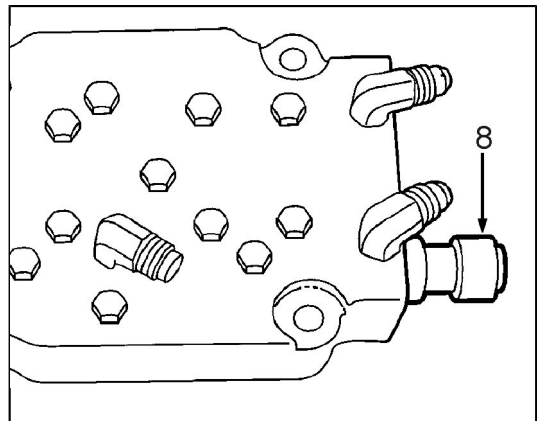
TRANSMISSION

RANGE SELECTOR VALVE

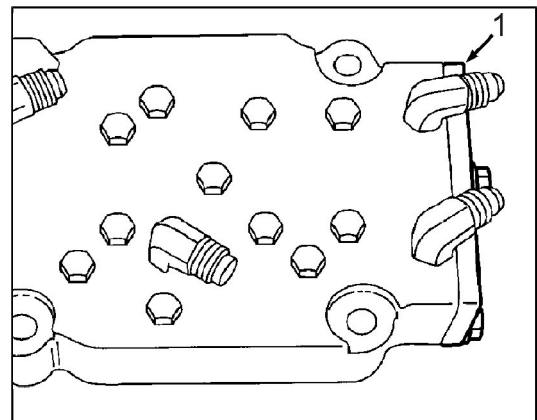
2. Install the range selector spool (5) into its housing bore.



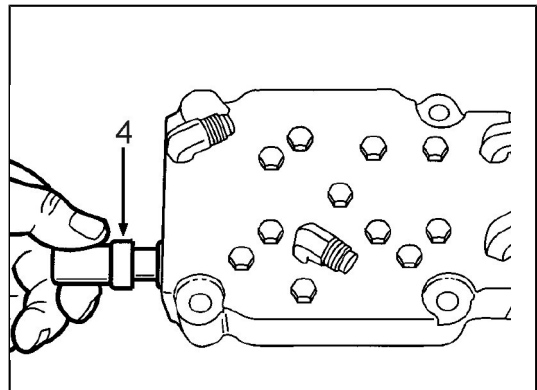
3. Install the directional selector spool (8) into its housing bore.



4. Install the end cover (1) and secure with the hardware.

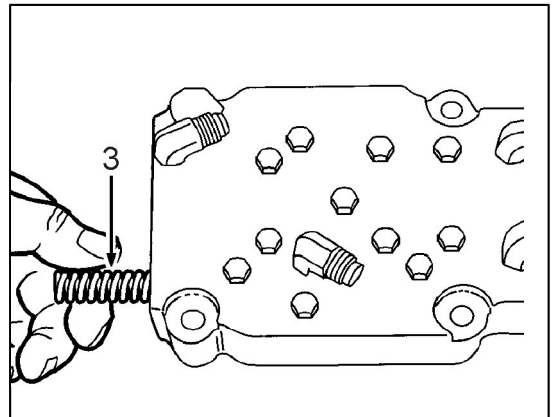


5. Install the switch spool (4) into its housing bore.

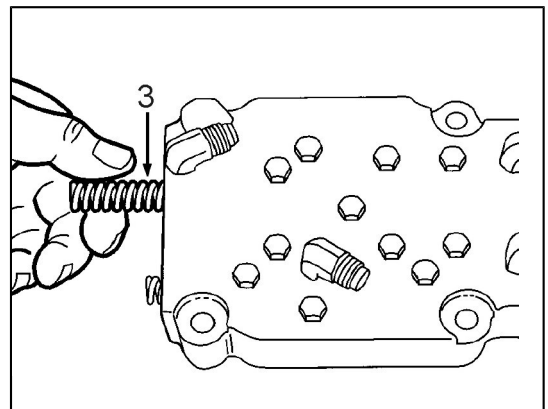


RANGE SELECTOR VALVE

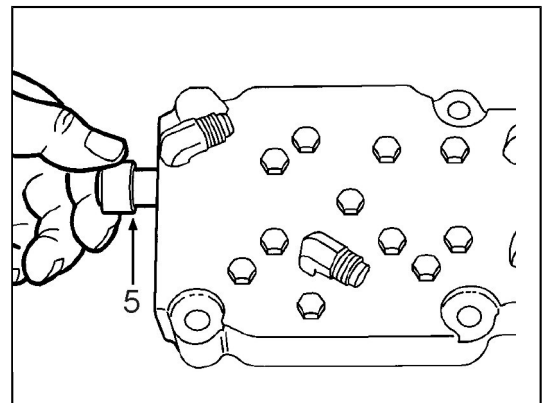
6. Install the switch spool return spring (3) into the spool.



7. Install the range spool return spring (3) into the spool.



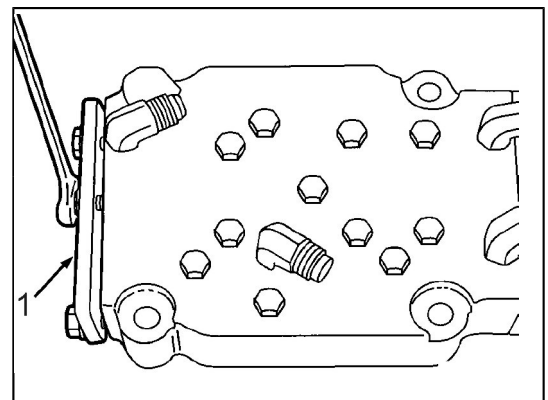
8. Install the remaining range selector spool (5) into its housing bore.



9. Install the end cover (1) and secure with hardware. Torque the bolts to 26 - 28 [Nm].



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when assembling.



TRANSMISSION

RANGE SELECTOR VALVE

10. Position the valve and O-rings on top of the transmission housing and secure with bolts and washers. Torque the bolts to 32 [Nm].
11. Reconnect the hoses at the range selector valve.
12. Check the oil level in the main frame as described in the OPERATOR'S MANUAL.

IMPORTANT! As soon as the engine starts, observe the transmission main and range clutch oil pressure warning lamp on the dash. If lights, immediately turn off engine.

13. Start the engine. Check for leaks. Check oil pressures as described in TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST, under SERVICE DIAGNOSIS in SECTION 7.
14. Install the center floor plate between seat and instrument panel. Install the floor mat, if cab equipped.

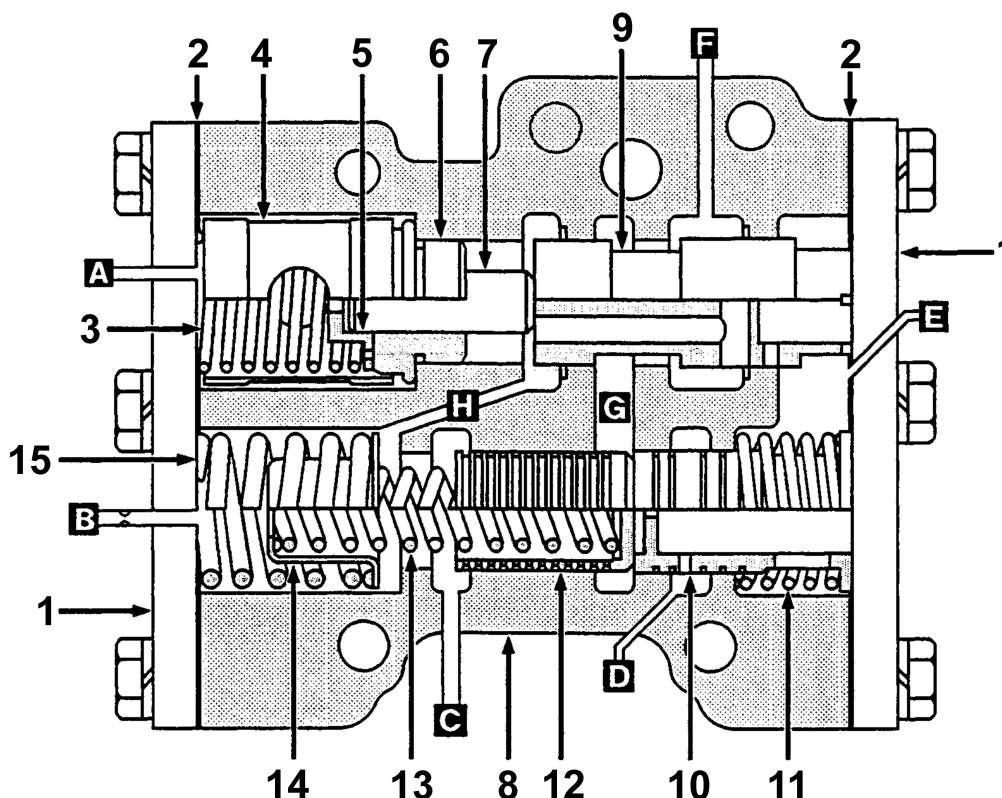
RATE OF RISE VALVE**17. DESCRIPTION (Refer to Fig. 7C.67A)**

Fig. 7C.67A. Cross Section View of Rate Of Rise Valve

- | | | |
|---|---|-------------------------|
| A. Main Pressure Oil | E. Main Oil Pressure to Directional Spool | |
| B. Orificed Main Pressure Oil | F. Main Oil Pressure to Range Spools | |
| C. Drain Port | G. Internal Passage | |
| D. Main Pressure Oil from Short Directional Spool | H. Internal Passage | |
| 1. End Cover | 6. Sequence Valve Spacer | 11. Reducing Spring |
| 2. Gasket | 7. Dowel Pin | 12. Modulating Piston |
| 3. Sequence Spool Spring | 8. Valve Housing | 13. Inner Piston Spring |
| 4. Spring Spacer | 9. Sequence Valve Spool | 14. Spring Retainer |
| 5. Sequence Valve Disc | 10. Reducing Spool | 15. Outer Piston Spring |

The rate of rise valve is a sequencing, pressure regulating valve use to provide a smooth shift without shock. This valve controls the length of time that it takes to fully pressurize a clutch pack and also allows the directional clutch pack to engage before range pack clutch.

Theory of operation

The rate of rise valve has six ports (A to F) and two passages (G and H) which are located on the bottom of the valve but which are shown in cross section on the sides of the valve, for clarity. Main pressure oil from the main regulator valve enters the left hand upper cavity through port A and keeps this cavity at main pressure whenever the engine is running. Main pressure oil from the main regulator valve enters the left hand lower cavity through port B. This port contains an orifice that limits the flow of oil into this cavity. This lower cavity is open to drain port C. The modulating piston (12) acts as a variable orifice for this drain to control pressure in this cavity.

TRANSMISSION

RATE OF RISE VALVE

Pressure oil from the range selector valve enters the right side of the lower cavity through port D only when the short directional spool in the range selector valve is shifted. This oil is directed out of the valve through ports E and F. Port E directs oil to the directional spool of the range selector valve. Port F directs oil to the range spools of the range selector valve but its flow is controlled by the sequence spool (9).

In neutral, the range selector valve cuts off all oil flow to port D and opens it to drain. Without any oil pressure in the right cavity of the valve, both spools (9 and 10) will shift right. Tension from springs (13 and 15) holds the modulating piston (12) to the right, leaving drain port C open. Oil entering the left cavity through port B will flow freely to the drain port C and no pressure will build in this cavity. Oil pressure from port A, along with the tension from spring (3), holds the sequence spool (9) to the right, allowing oil from port F to pass through the spool and out drain port C.

When a shift occurs, the range selector valve directs oil to port D. This oil flows through the holes in the reducing spool (10) and exits through port E to fill the directional clutch pack. Some oil can also pass through the orifice in the end of the reducing spool (10), but because the passage G is still open to drain, the modulation piston (12) will not shift. When the directional clutch pack is full, pressure begins to build in the clutch pack and in the cavity on the right side of the rate of rise valve. As pressure builds, the sequence spool (9) begins to move against the tension of the spring (3) and main pressure from port A. As this spool moves to the left, the metering holes in the sequence spool (9) index with port F and the drain holes in the left side of the spool are cut off from passage H. Oil from port D can now pass through the metering holes in the sequence spool (9) to port F to fill the range clutch pack. Because oil must pass through the metering holes, pressure in the right hand cavity of the valve and pressure to the directional clutch pack will remain higher than the pressure at port F going to the range clutch pack. During the range clutch pack fill sequence, the sequence spool (9) also blocked off passage G. Oil passing through the orifice in the end of the reducing spool (10) begins to build pressure against the modulating piston (12), pushing it slowly to the left against the springs (13 and 15). The modulating piston (12) has a series of orifices which decrease in size from left to right. As the piston (12) moves to the left, decreasing size holes index with drain port C causing a restriction to flow of oil from port B. This causes pressure to build against the back side of the piston (12) which slows its left hand movement, which in turn allows the build up of pressure in the clutch packs.

RATE OF RISE VALVE

18. REMOVAL AND DISASSEMBLY (Refer to Fig. 7C.68 and 7C.69)

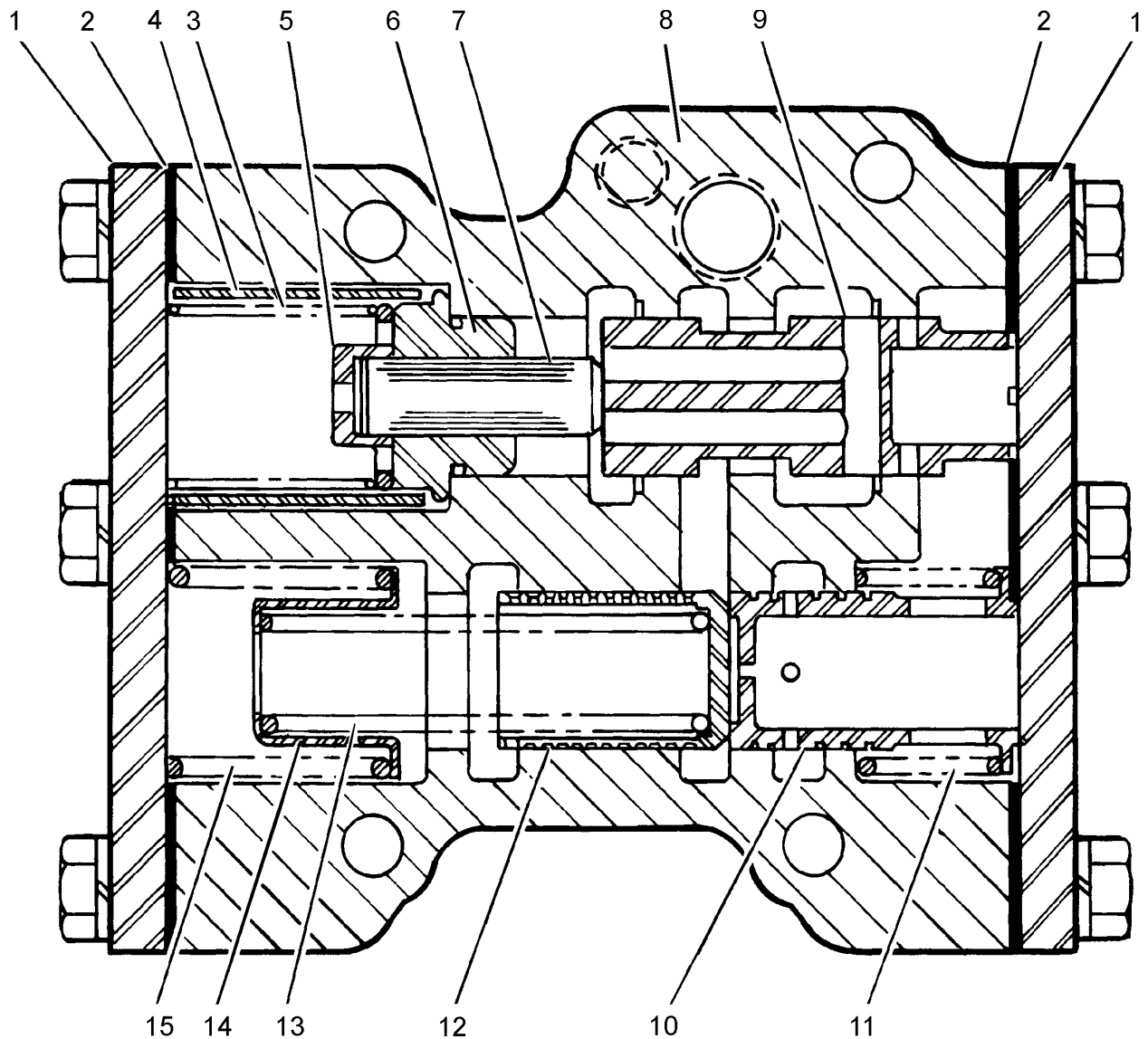


Fig. 7C.68. Cross Section of Rate of Rise Valve

- | | |
|--------------------------|-------------------------|
| 1. End Cover | 9. Sequence Valve Spool |
| 2. Gasket | 10. Reducing Spool |
| 3. Sequence Spool Spring | 11. Reducing Spring |
| 4. Spring Spacer | 12. Modulating Piston |
| 5. Sequence Valve Disc | 13. Inner Piston Spring |
| 6. Sequence Valve Spacer | 14. Spring Retainer |
| 7. Dowel Pin | 15. Outer Piston Spring |
| 8. Valve Housing | |

TRANSMISSION

RATE OF RISE VALVE

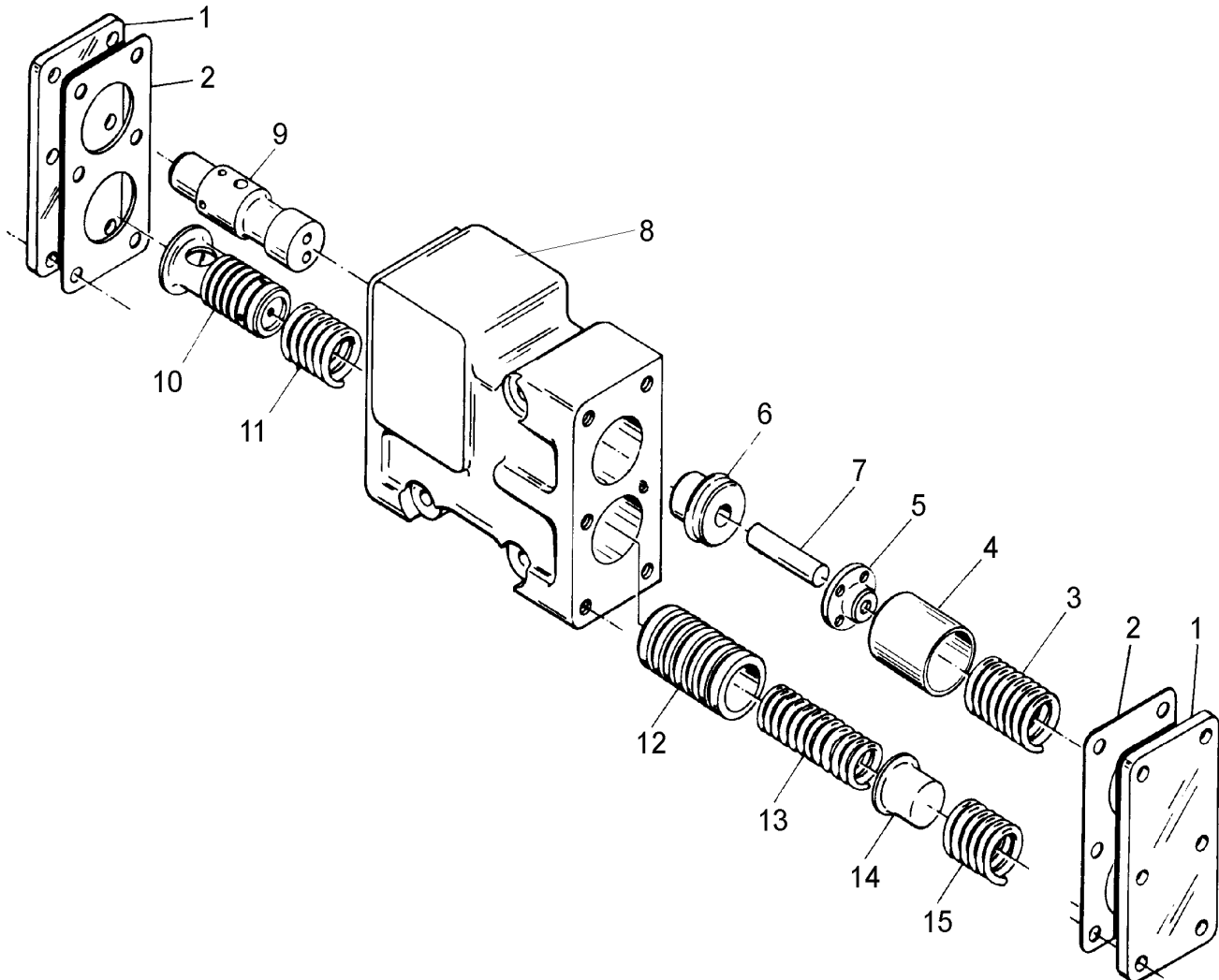


Fig. 7C.69. Exploded View of Rate of Rise Valve

- | | | |
|--------------------------|--------------------------|-------------------------|
| 1. End Cover | 6. Sequence Valve Spacer | 11. Reducing Spring |
| 2. Gasket | 7. Dowel Pin | 12. Modulating Piston |
| 3. Sequence Spool Spring | 8. Valve Housing | 13. Inner Piston Spring |
| 4. Spring Spacer | 9. Sequence Valve Spool | 14. Spring Retainer |
| 5. Sequence Valve Disc | 10. Reducing Spool | 15. Outer Piston Spring |

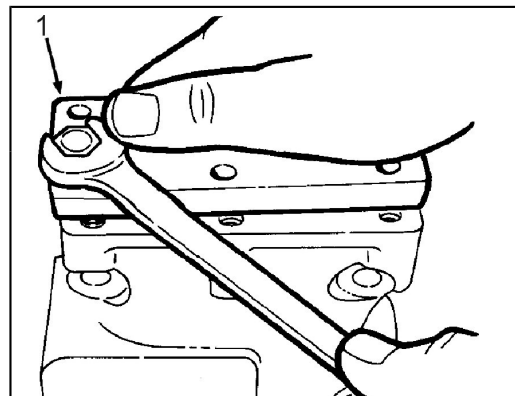
1. Remove floor mat (cab equipped machines). Remove the bolts securing the center floor plate between seat and instrument panel and remove the plate.
2. Disconnect the hoses at rate of rise valve and tag them.
3. Remove the bolts and washers securing the valve assembly to the top of the transmission housing. Remove the valve assembly and gasket. Discard the gasket.

RATE OF RISE VALVE

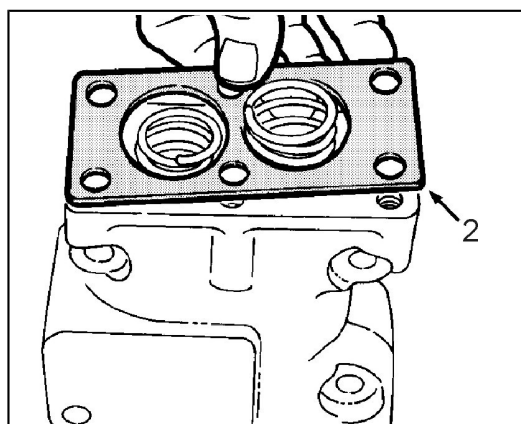
4. While holding down on the end cover (1), slowly let off the mounting bolts until all the spring tension is released. Then remove the cover.



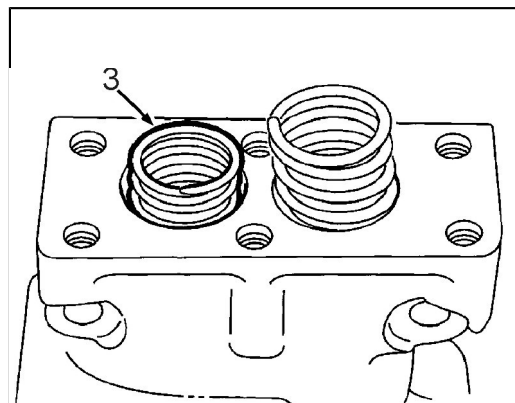
WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.



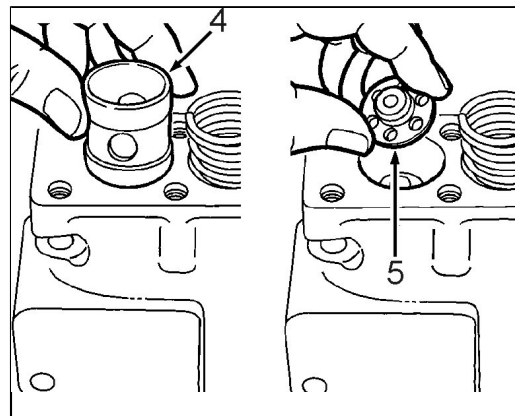
5. Remove and discard the end cover gasket (2).



6. Remove the sequence spool spring (3) from the housing bore.



7. Remove the spring spacer (4) from the housing bore.
8. Remove the sequence valve disc (5) from the housing bore.



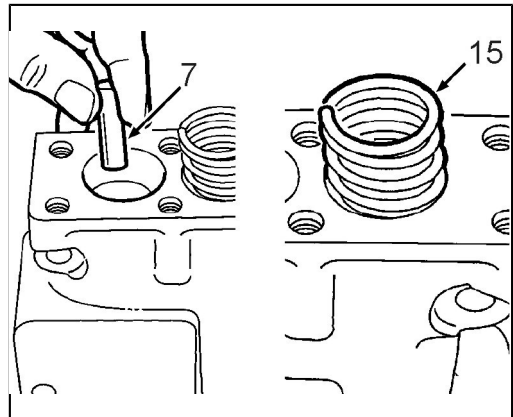
SECTION 7C

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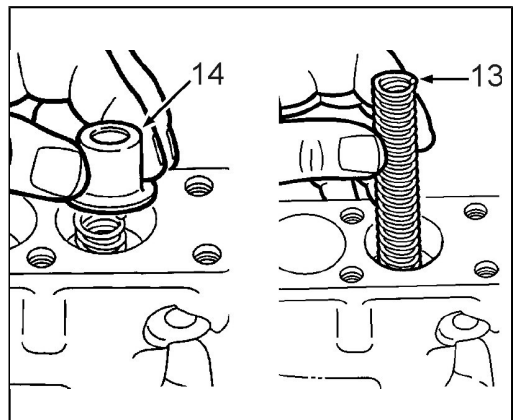
TRANSMISSION

RATE OF RISE VALVE

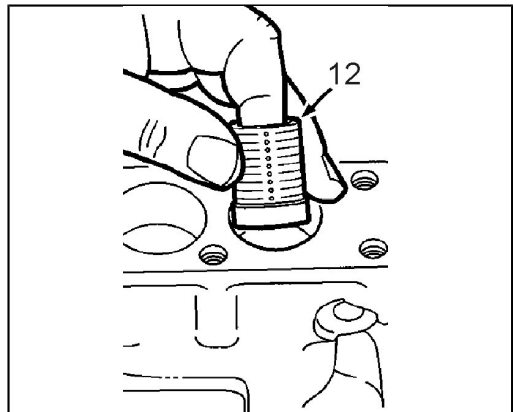
9. Remove the dowel pin (7) from the housing bore.
10. Remove the outer piston spring (15) from the housing bore.



11. Remove the spring retainer (14) from the housing bore.
12. Remove the inner piston spring (13) from the housing bore.



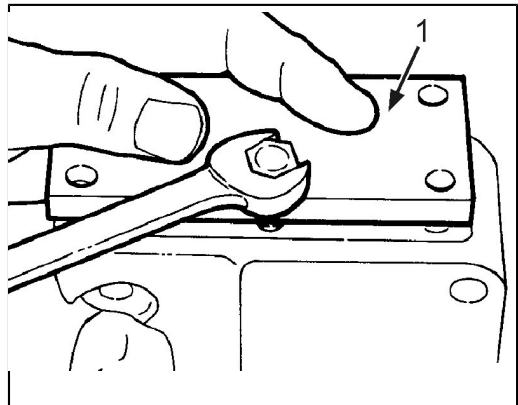
13. Remove the modulating piston (12) from the housing bore.



14. Slowly remove the second end cover (1) hardware until all the spring tension is released. Remove the cover.

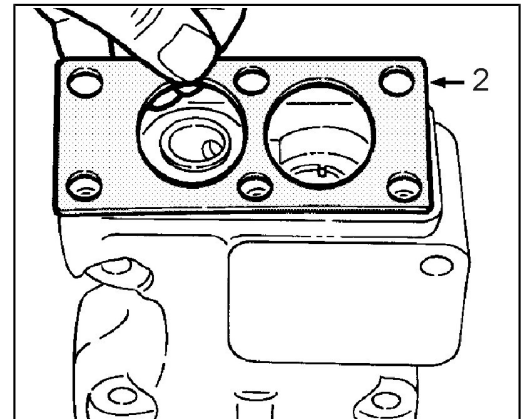


WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.



RATE OF RISE VALVE

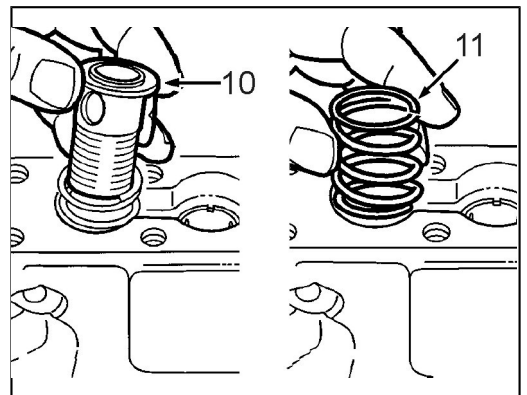
15. Remove and discard the end cover gasket (2).



16. Remove the reducing spool (10) from the housing bore.

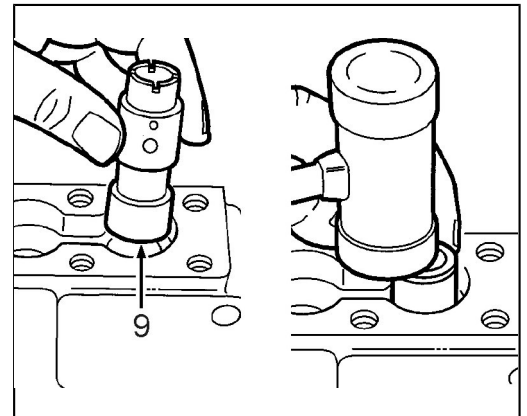
17. Remove the reducing spool spring (11) from the housing bore.

NOTE: The spool is to be kept with the housing bore side that it was removed from.

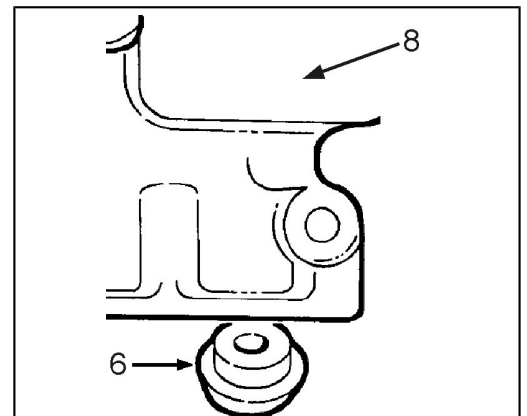


18. Remove the sequence valve spool (9) from the housing bore.

19. Using a wooden dowel pin, insert into the housing bore up against the sequence spool spacer. Gently tap on dowel to dislodge the spacer from the housing.



18. Remove the sequence valve spacer (6) from the housing (8).



TRANSMISSION

RATE OF RISE VALVE

19. INSPECTION AND REPAIR

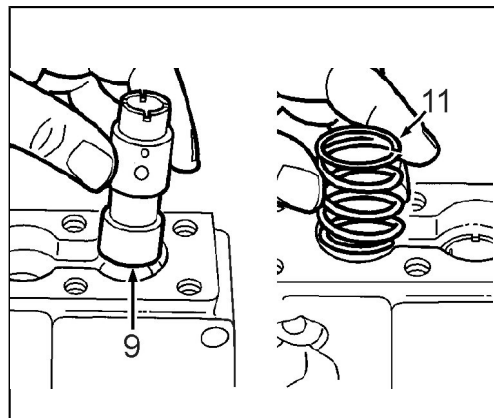
1. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all the oil passages in the valve housing are clean and free of obstructions.
2. Inspect the parts for excessive wear and replace if necessary.
3. Inspect the condition of the springs. If they are damaged or do not fall within the specifications shown in SPECIFICATIONS, under TRANSMISSION in this Section, they must be replaced.

20. REASSEMBLY AND INSTALLATION (Refer to Fig. 7C.68 and 7C.69)

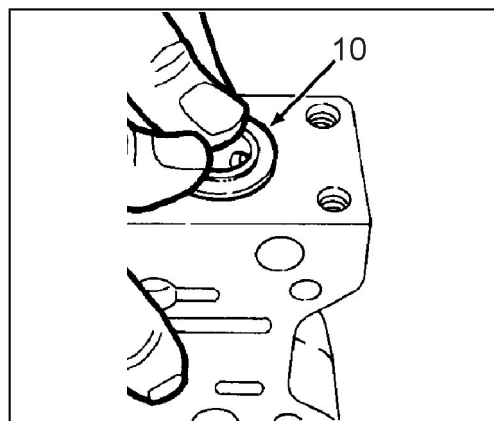
NOTE: Lubricate the spools and valve bores with transmission oil upon reassembly.

NOTE: Springs (11) and (15) appear to be identical, however they are different. Intermixing will result in loss of range clutch pressure and loss of directional pressure.

1. Install the sequence valve spool (9) into housing bore.
2. Install reducing spool spring (11) into housing bore.

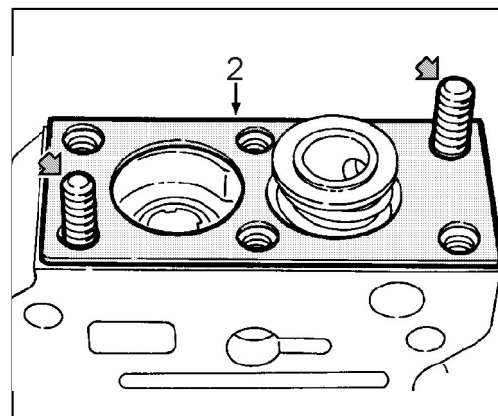


3. Seat the reducing spool (10) in the housing bore.



RATE OF RISE VALVE

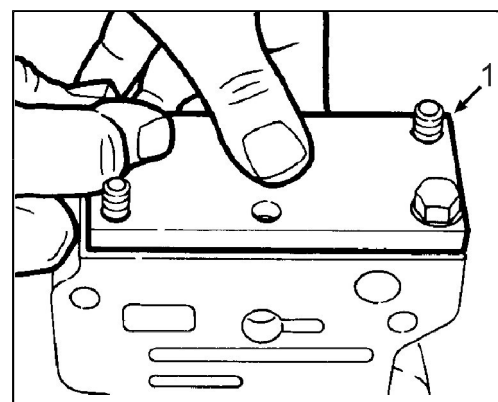
4. Insert the aligning studs to the housing. Install a new end cover gasket (2) to the housing.



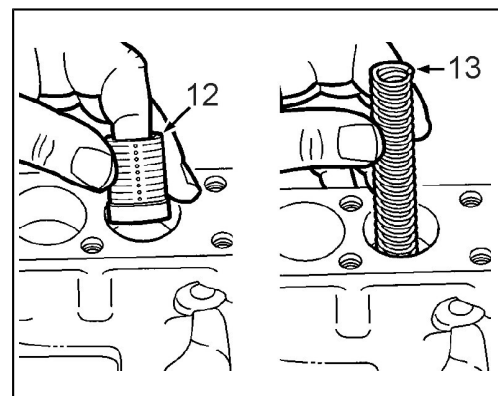
5. Install the end cover (1) over the aligning studs and secure with four bolts. Remove the aligning studs and install the remaining bolts.



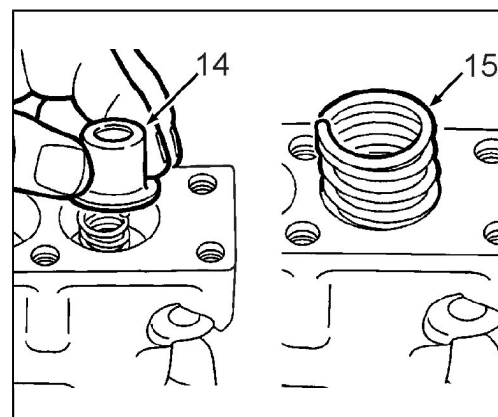
WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when assembling.



6. Install the modulating piston (12) into the housing bore.
7. Install the inner piston spring (13) into the modulating piston in the housing bore.



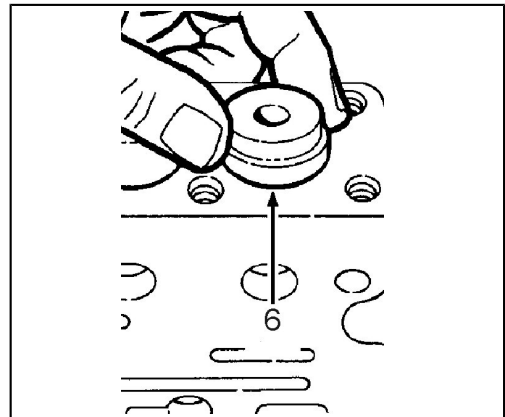
8. Install the spring retainer (14) over the spring.
9. Install the outer piston spring (15) over the retainer.



TRANSMISSION

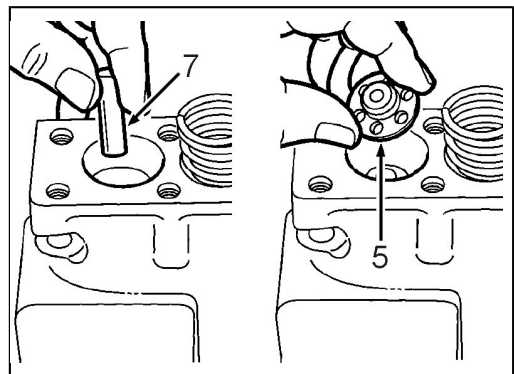
RATE OF RISE VALVE

10. Squarely seat the sequence valve spacer (6) into the housing bore.

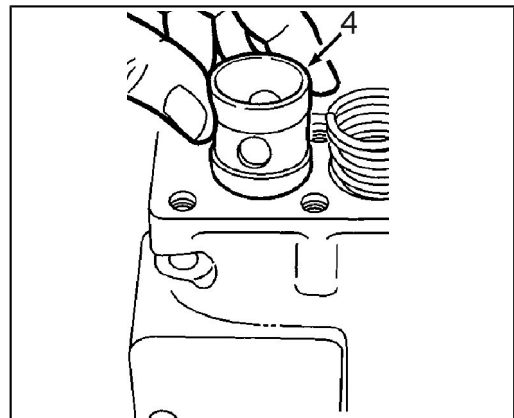


11. Install the dowel pin (7) in the housing bore into the sequence spool spacer.

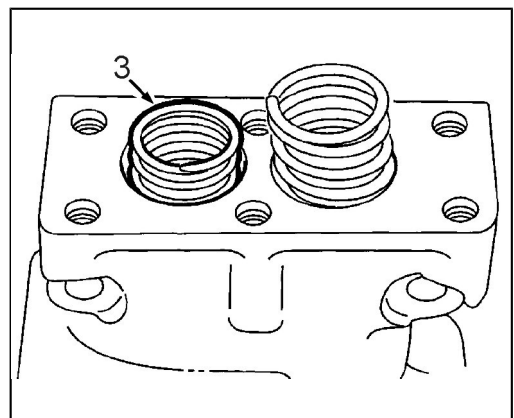
12. Install the sequence valve disc (5) on the dowel pin.



13. Install the spring spacer (4).

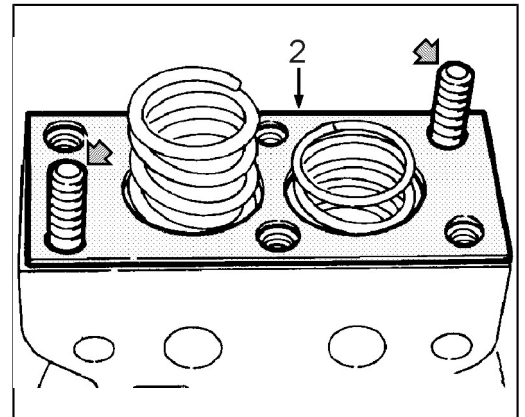


14. Install the sequence spool spring (3) inside the spring spacer.



RATE OF RISE VALVE

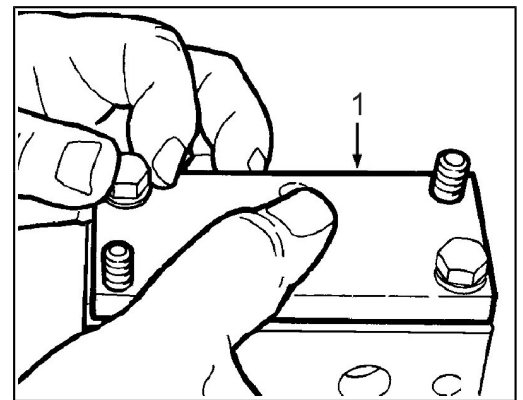
15. Insert the aligning studs to the housing. Install a new end cover gasket (2) to the housing.



16. Install the end cover (1) over the aligning studs and secure with four bolts. Remove the aligning studs and install the remaining bolts. Tighten the bolts securing covers (1) to a torque of 26 to 28 [Nm].



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when assembling.



17. Position the valve with new gasket on top of the transmission housing and secure with bolts and washers. Torque the bolts to 32 [Nm].
18. Reconnect the hoses at the range selector valve.
19. Check the oil level in the rear main frame as described in the OPERATOR'S MANUAL.

IMPORTANT! As soon as the engine starts, observe the transmission main and range clutch oil pressure warning lamp on the dash. If lights, immediately turn off engine.

20. Start the engine. Check for leaks. Check oil pressures as described in TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST in SECTION 7.
21. Install the center floor plate between seat and instrument panel. Install the floor mat, if cab equipped.

TRANSMISSION

DRIVE TRAIN CONTROL VALVE

21. REMOVAL



WARNING! Before working on a machine, be sure that the blade and ripper have been lowered to the ground, the engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and controls are tagged to prevent inadvertent engine starting.

IMPORTANT: When disconnecting hydraulic lines for any reason, they should be properly capped with correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt or lint into critical hydraulic components of machine. Tag all disconnect oil lines to facilitate easier installation.

1. Unscrew bolts (4, Fig. 7C.70) and remove L.H. enclosure with L.H. door.
2. Disconnect the electrical harness from the filter base (3, Fig. 7C.71). Unscrew bolts (4) mounting filters bracket (1) to ROPS bracket and allow the bracket (1) with filters (2) to be supported by the hoses.
3. Unscrew bolts (2, Fig. 7C.70) and remove access cover (1) in order to obtain access to mounting points of the drive train control valve.

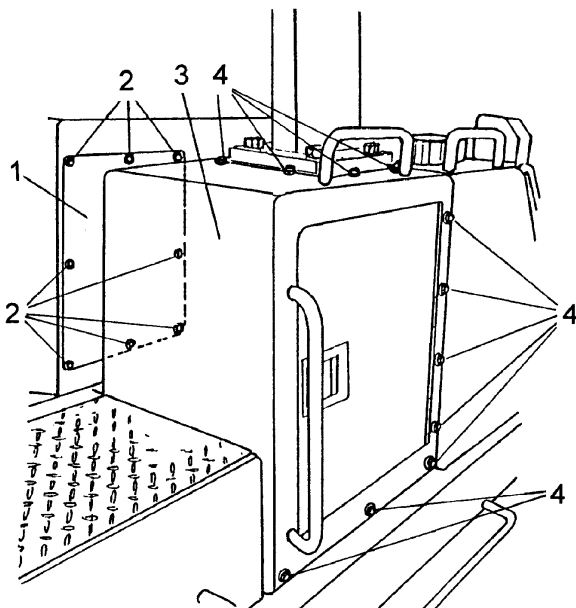


Fig. 7C.70. Disassembly Cover

- | | |
|-----------------|-------------------|
| 1. Access Cover | 3. L.H. Enclosure |
| 2. Bolts | 4. Bolts |

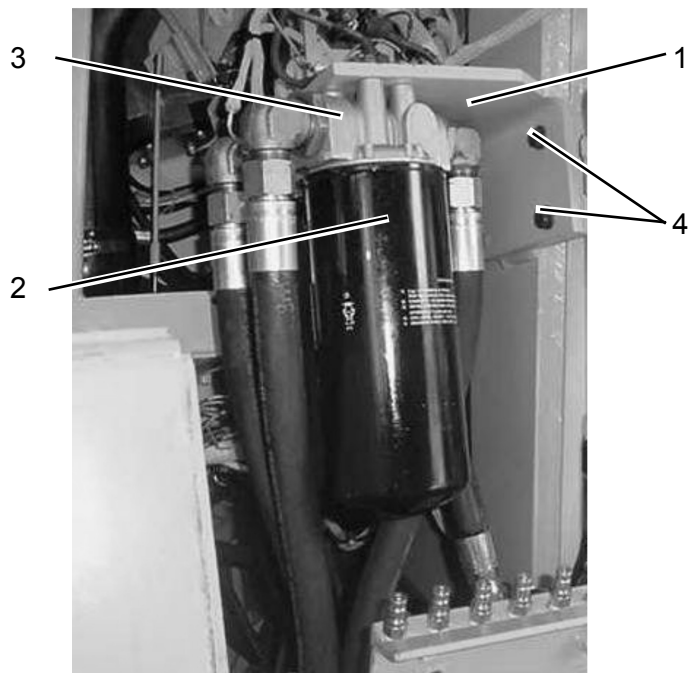


Fig. 7C.71. Pilot Control Valve Disconnecting Points

- | | |
|--------------------|----------------|
| 1. Filters Bracket | 3. Filter Base |
| 2. Filter | 4. Bolts |

4. Disconnect drive train control lever harness (3, Fig. 7C.73).
5. Remove the screws (2, Fig. 7C.72) and remove cover (1).
6. Remove two stiffener plates and unscrew control lever (5). Remove control lever (5, Fig. 7C.72) with attached boot and electrical harness.

DRIVE TRAIN CONTROL VALVE

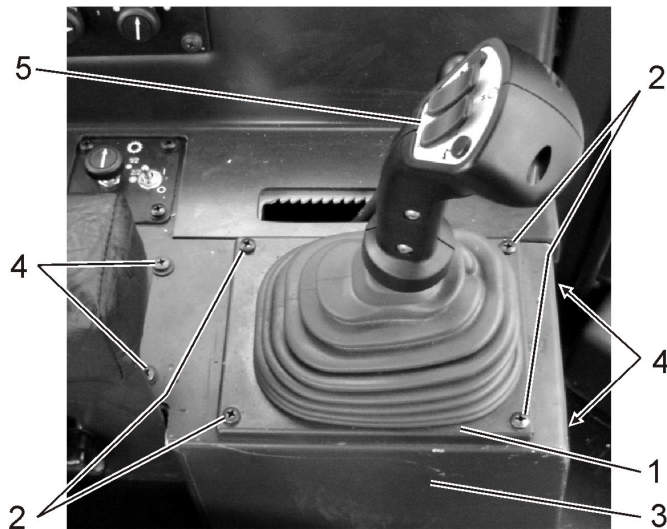


Fig. 7C.72. Disassembly Console to Access Drive Train Control Valve

- | | |
|------------------|------------------|
| 1. Cover | 4. Bolts |
| 2. Screws | 5. Control Lever |
| 3. Valve Console | |

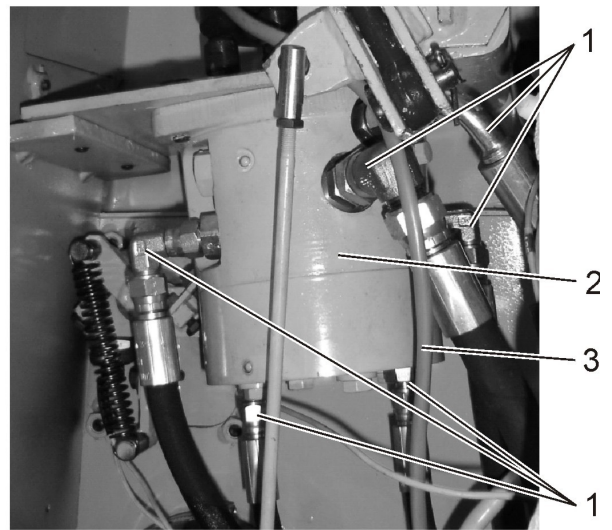


Fig. 7C.73. Drive Train Control Valve Disconnecting Points

- | |
|------------------------------|
| 1. Hoses |
| 2. Drive Train Control Valve |
| 3. Control Lever Harness |

7. Disconnect and tag all hoses (1, Fig. 7C.73) connected to the drive train control valve (2).
8. Unscrew four mounting bolts (4, Fig. 7C.72) securing valve console (3) to the platform and remove console (3) out of the platform.
9. Unscrew four mounting bolts (1, Fig. 7C.74) securing valve bracket (2) to the platform and remove the valve with bracket from the platform. Unscrew three mounting bolts (3) securing drive train control valve (4) to valve bracket (2) and remove the bracket (2) out of the valve (4).

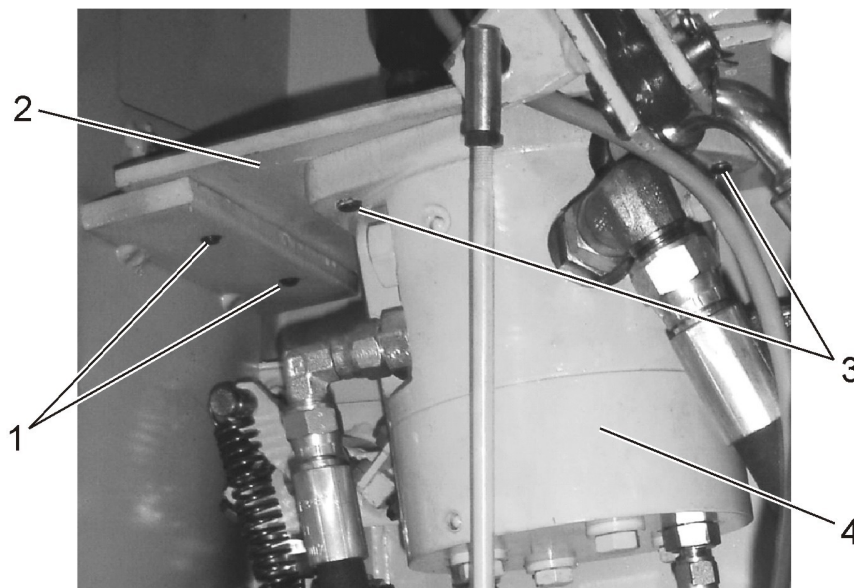


Fig. 7C.74. Drive Train Control Valve Disconnecting Points

- | | |
|-------------------|-------------------|
| 1. Mounting Bolts | 3. Mounting Bolts |
|-------------------|-------------------|

TRANSMISSION

2. Valve Bracket

4. Drive Train Control Valve

DRIVE TRAIN CONTROL VALVE

22. DISASSEMBLY (Refer to Fig.'s 7C.75 and 7C.76)

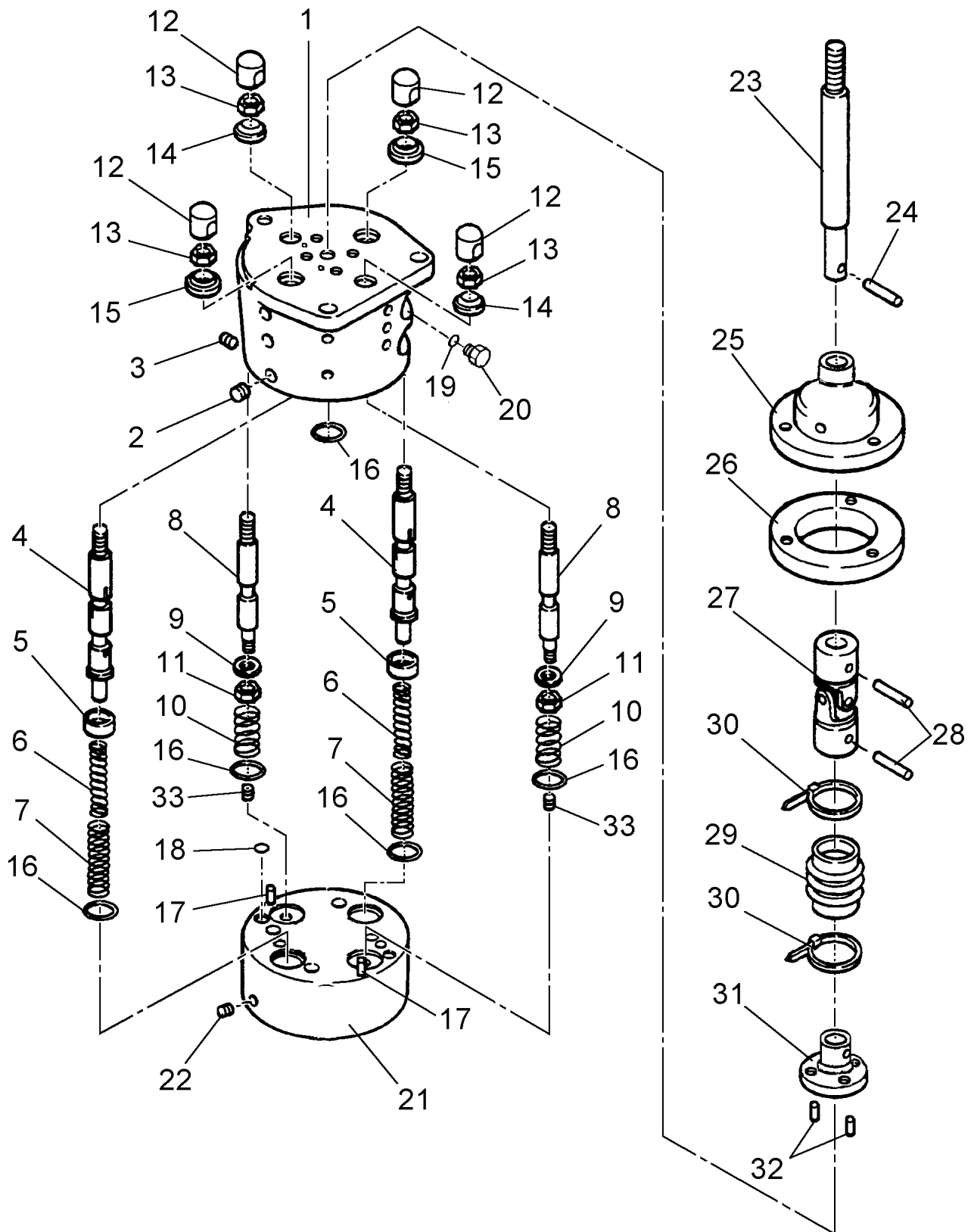


Fig. 7C.75. Exploded View of Drive Train Control Valve

TRANSMISSION

DRIVE TRAIN CONTROL VALVE

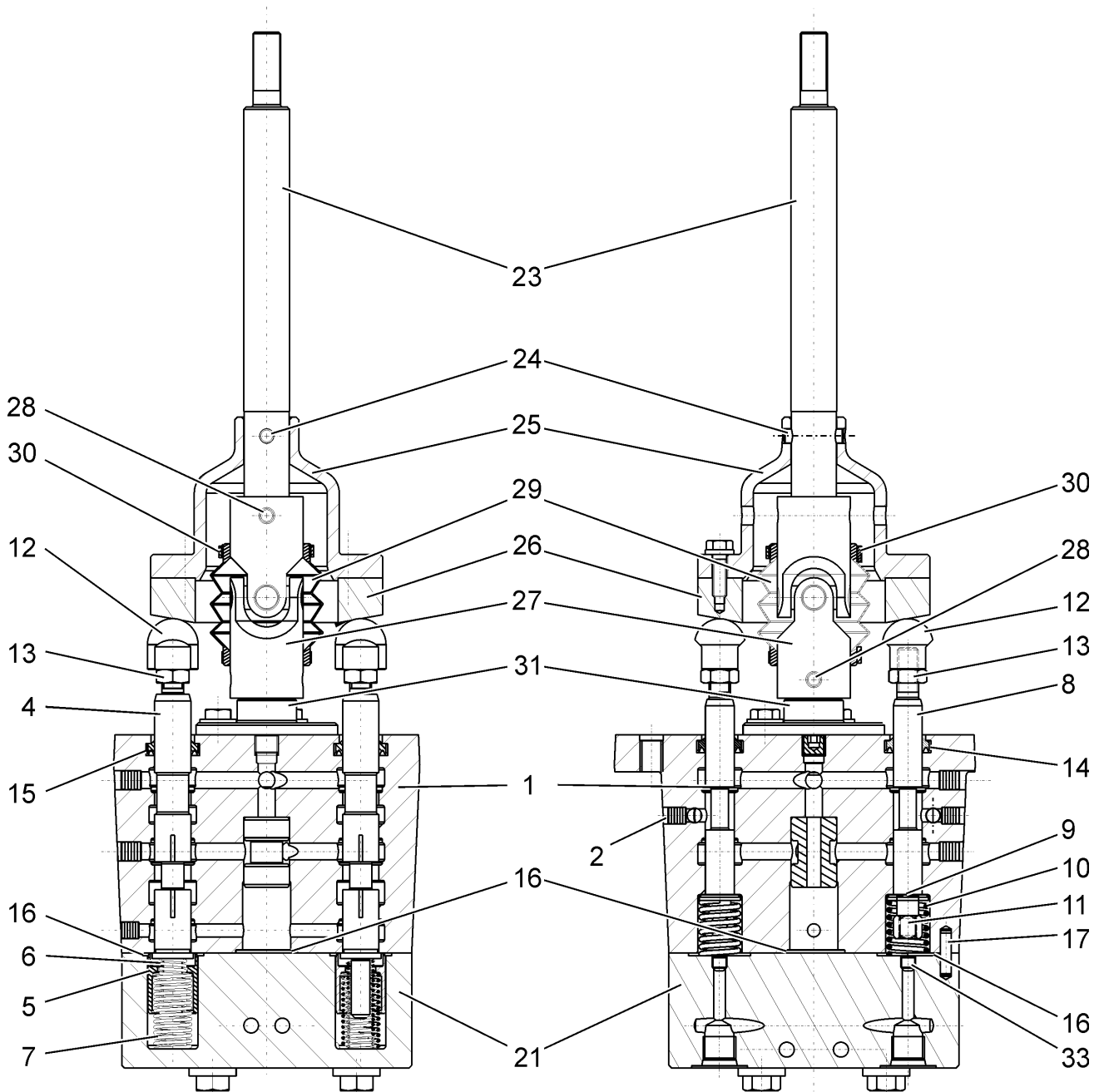


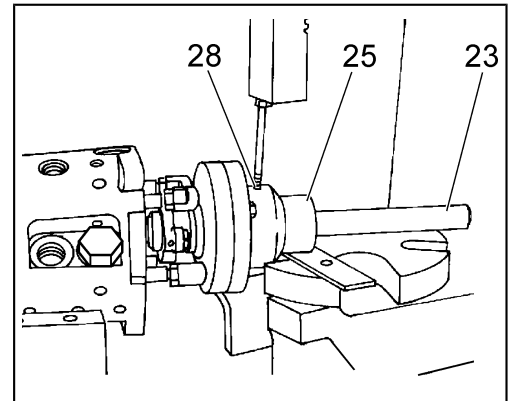
Fig. 7C.76. Cross Section View of Drive Train Control Valve

Legend for Fig. 7C.75 and Fig. 7C.76

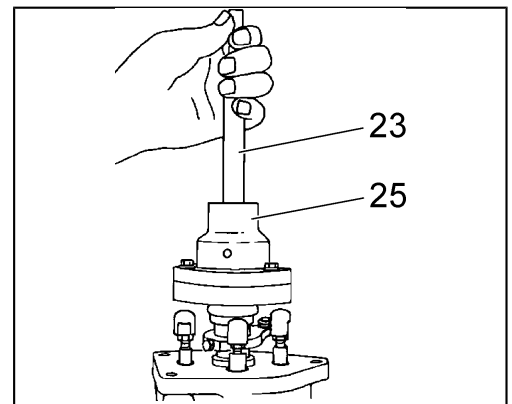
- | | | | |
|----------------------|------------------------------|-------------------|--------------------------|
| 1. Housing Assy | 10. Directional Spool Spring | 18. O-Ring | 26. Pivot Ring |
| 2. Port Plug | 11. Stop Nut | 19. O-Ring | 27. Universal Joint |
| 3. Port Plug | 12. Rocker End | 20. Plug | 28. Dowel Pin |
| 4. Steering Spool | 13. Jam Nut | 21. Bottom Cover | 29. Universal Joint Boot |
| 5. Guide Sleeve | 14. Seal Ring | 22. Port Plug | 30. Strip |
| 6. Inner Spring | 15. Seal Ring | 23. Lever | 31. Joint Base |
| 7. Outer Spring | 16. O-Ring | 24. Dowel Pin | 32. Dowel Pin |
| 8. Directional Spool | 17. Dowel Pin | 25. Joint Housing | 33. Orifice Plug |
| 9. Thrust Washer | | | |

DRIVE TRAIN CONTROL VALVE

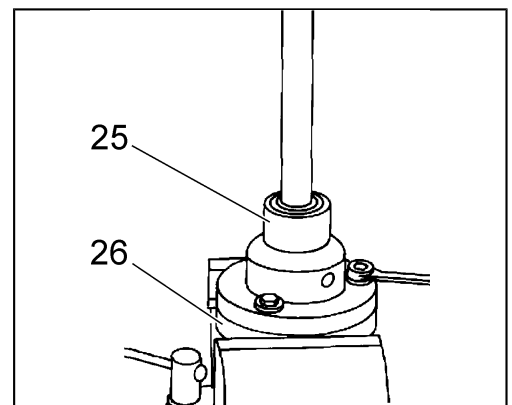
1. Position the valve in press with the hole in the joint housing (25) aligned with the dowel pin (28) in the lever (23). Apply the press and drive the pin out clearing the housing with lever.



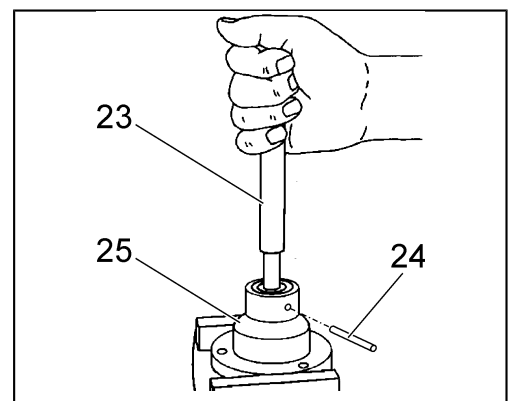
2. Remove the lever (23) with the joint housing (25) from the valve.



3. Position the assembly in a vise. Remove the hardware and separate the housing (25) from the pivot ring (26).



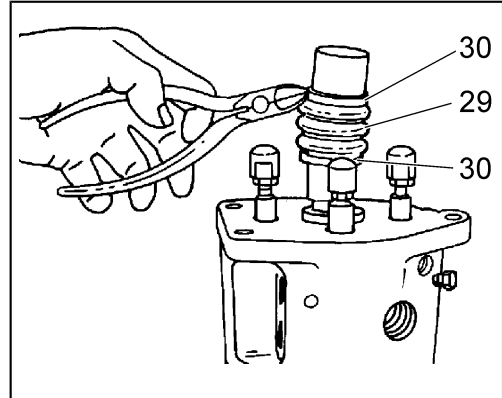
4. Drive the dowel pin (24) out from the housing (25). Remove the lever (23) from the joint housing (25).



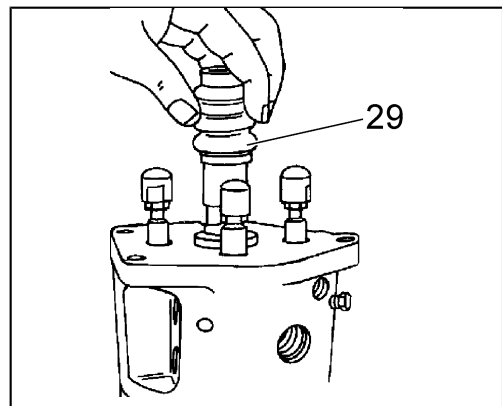
TRANSMISSION

DRIVE TRAIN CONTROL VALVE

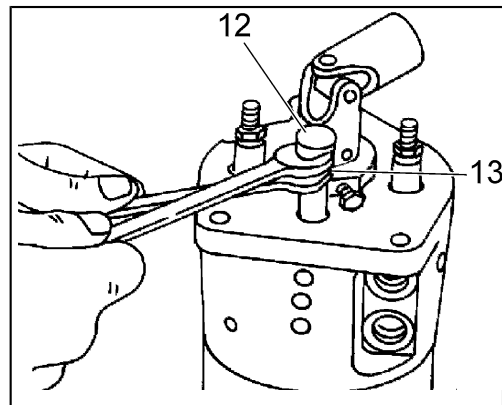
5. Cut and remove the tie straps (30) from the joint boot (29).



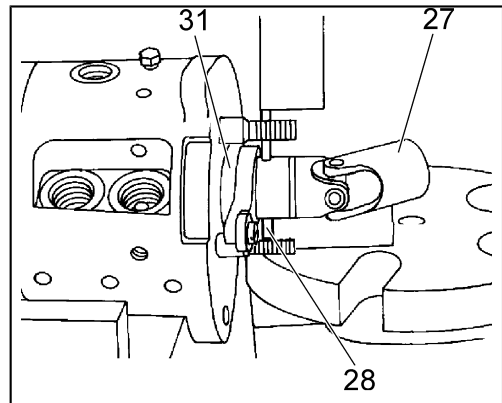
6. Remove the boot (29) from the universal joint.



7. Remove the spool rocker end (12) and jam nut (13) from each spool.

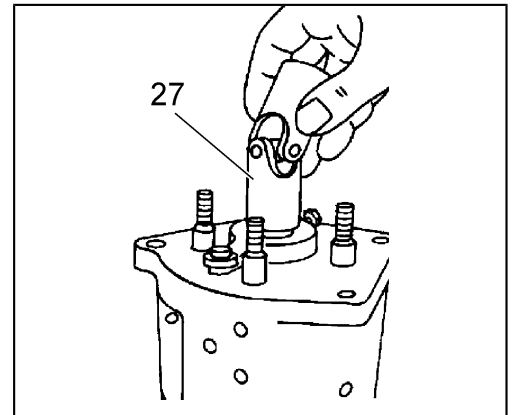


8. Position the assembly in a vise. Remove the dowel pin (28) connecting the universal joint (27) to the joint base (31).

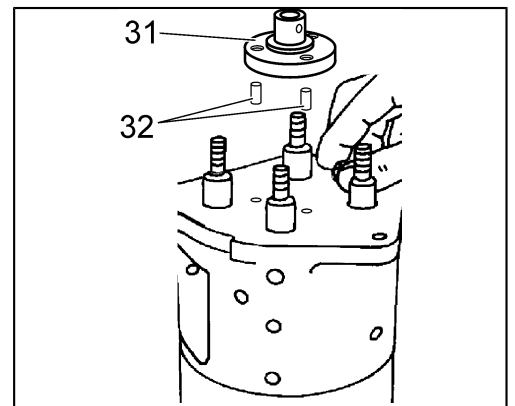


DRIVE TRAIN CONTROL VALVE

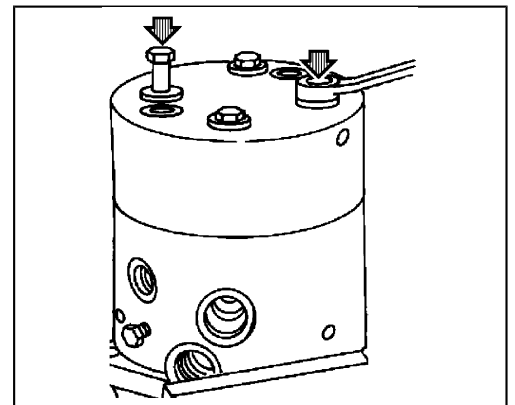
9. Remove the universal joint (27).



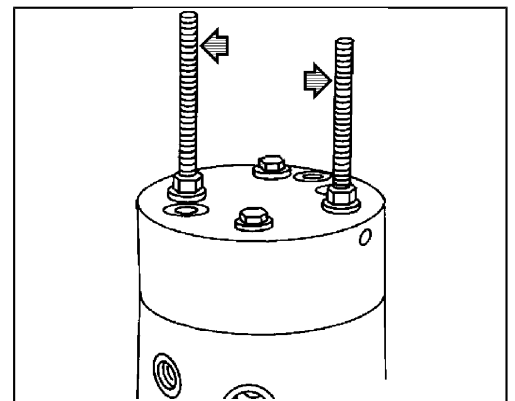
10. Unscrew four bolts and remove the joint base (31).
If required, remove two dowels pins (32) from the base (31).



11. Turn the valve over and remove the two opposite side mounting bolts.



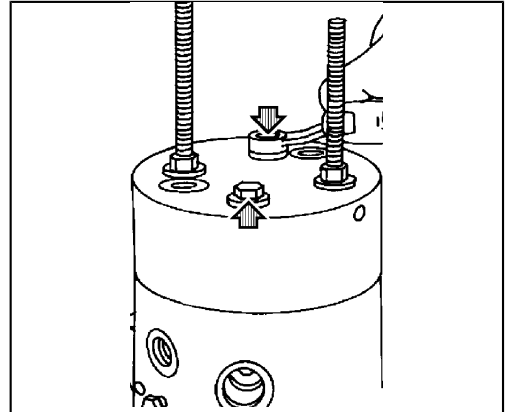
12. Install two threaded rods with washers and nuts to the vacated mounting holes.



TRANSMISSION

DRIVE TRAIN CONTROL VALVE

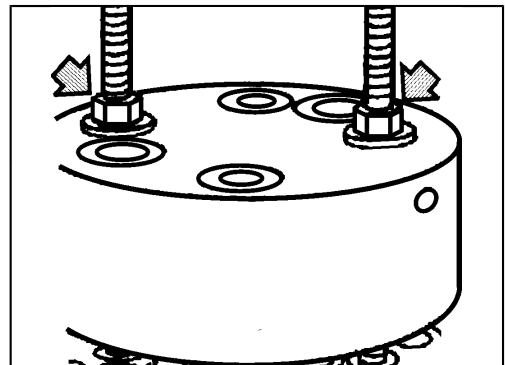
13. Remove remaining two mounting bolts.



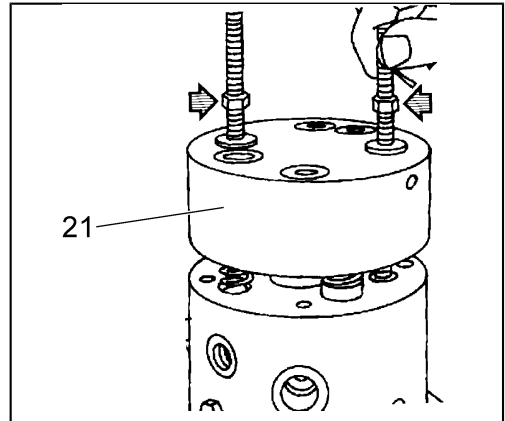
14. Let off each nut until all spring tension is relieved.



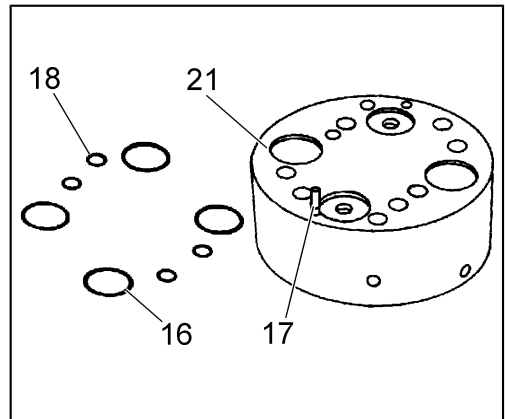
WARNING! Spring loaded assembly. Cover must be held to relieve spring pressure. Use extreme care when disassembling.



15. Remove the threaded rods and the bottom cover (21) from the valve.

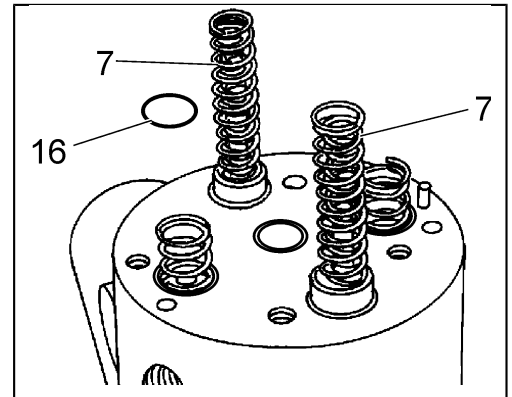


16. Remove and discard the O-rings (16 and 18) from the bottom cover (21). If necessary, remove dowel pin (17).

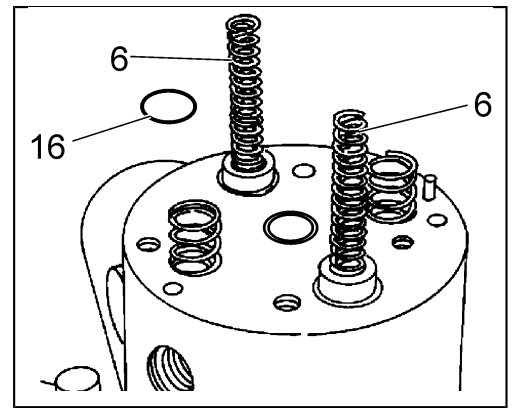


DRIVE TRAIN CONTROL VALVE

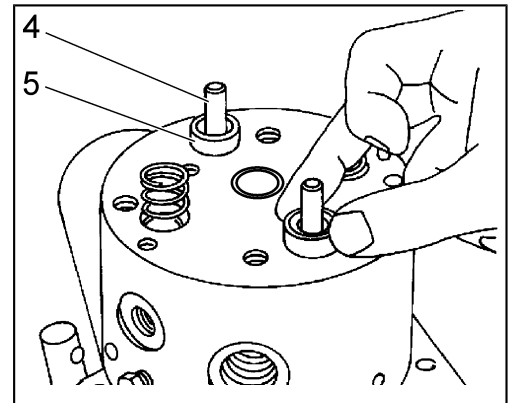
17. Remove and discard O-ring (16) from the valve housing. Remove the outer springs (7).



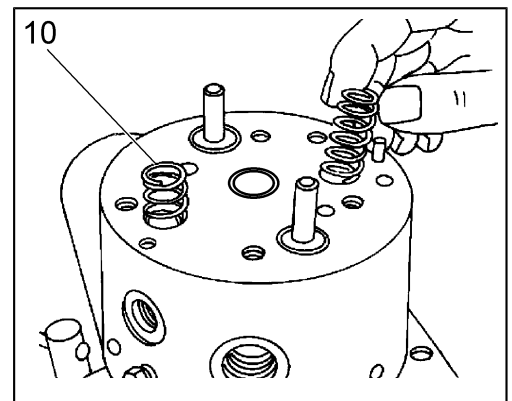
18. Remove the inner springs (6).



19. Remove the guide sleeve (5) from each steering spool (4).



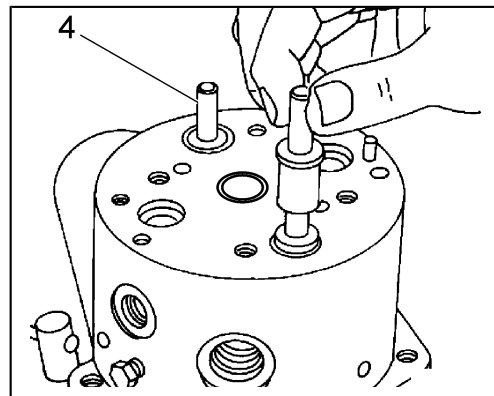
20. Remove the directional spool springs (10) at each directional spool in the valve housing.



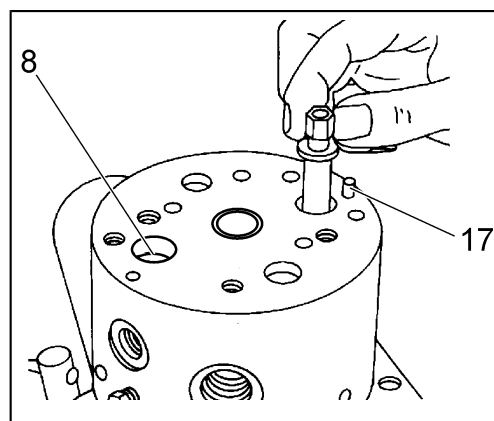
TRANSMISSION

DRIVE TRAIN CONTROL VALVE

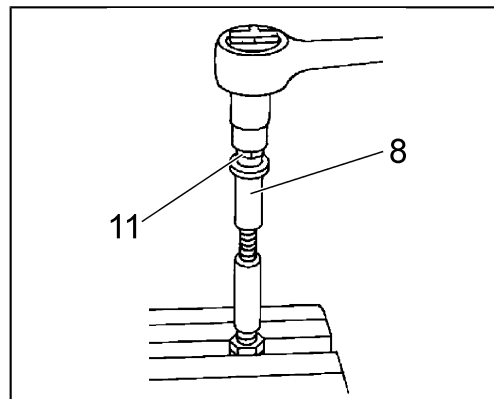
21. Remove the two steering spools (4) from the valve housing.



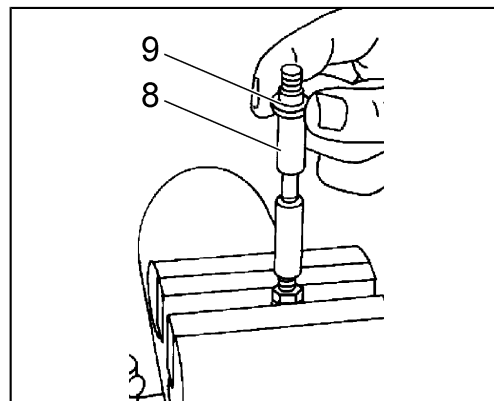
22. From under the valve housing, push the directional spool (8) up and out of the valve body. Repeat for remaining spool. If necessary, remove dowel pin (17).



23. Install two 3/8"NC nuts on the directional spool (8) and position in a vise. Remove the loctited stop nut (11) from the spool. Repeat for remaining spool.

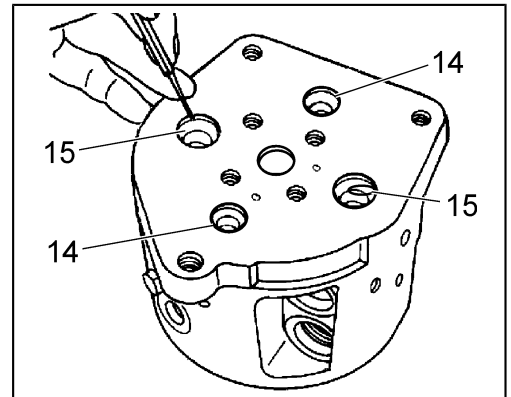


24. Remove the thrust washer (9) from the spool (8). Repeat for remaining spool.

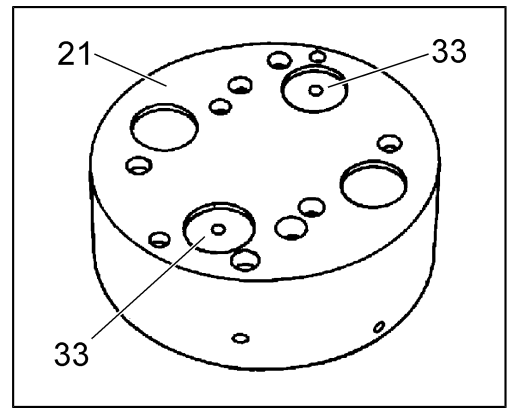


DRIVE TRAIN CONTROL VALVE

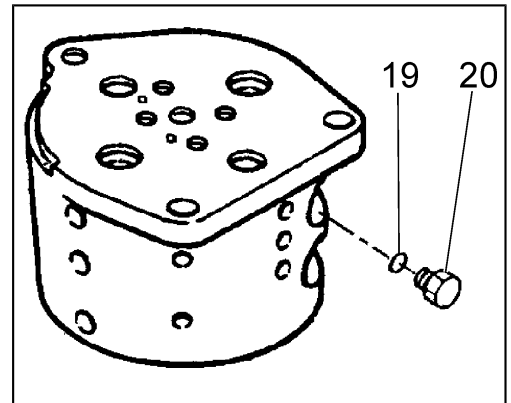
25. Remove and discard seal rings (14 and 15) from the valve housing.



26. Remove the orifice plugs (33) from the bottom cover (21).



27. Remove two plugs (20) with O-rings (19), if necessary.



TRANSMISSION

DRIVE TRAIN CONTROL VALVE

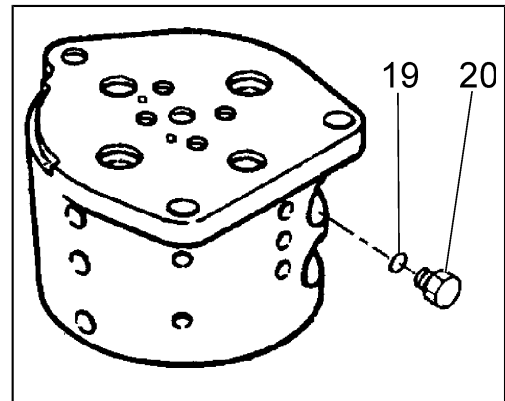
23. INSPECTION AND REPAIR

1. Clean all parts in a suitable cleaning solvent and blow dry with compressed air. Be sure all the oil passages in the valve spools and valve body are clean and free of obstructions.
2. Inspect the parts for excessive wear or scratches and replace if necessary.
3. All the sealing rings must be replaced.
4. Clean threads with a stiff brush and solvent. Check for damage.
5. Inspect the condition of the springs. If they are wore or damaged, they must be replaced.
6. Inspect the pivot ring and spool rocker ends for excessive wear or scratches and replace if necessary.

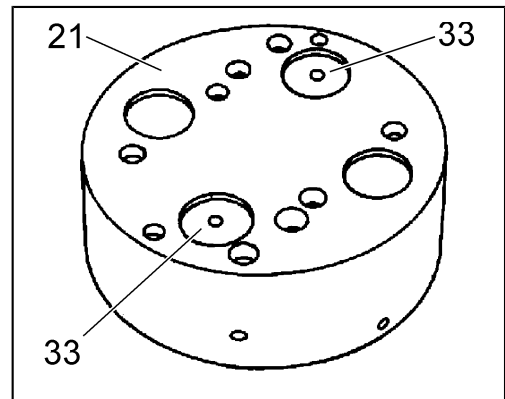
24. REASSEMBLY (Refer to Fig.'s 7C.75 and 7C.76)

IMPORTANT: Sealing rings should be lubricated with petroleum jelly for ease of assembly. The valve spools and theirs bores should also be lightly lubricated.

1. Install two plugs (20) with O-rings (19), if removed.

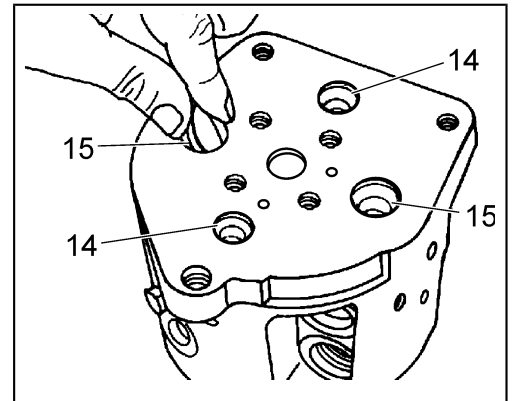


2. Install the orifice plugs (33) into the bottom cover (21). Torque the plugs to 2.7 [Nm].

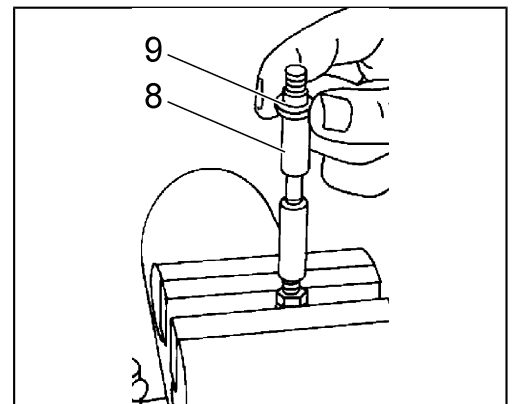


DRIVE TRAIN CONTROL VALVE

3. Install new seal rings (14 and 15), with the U cup portion facing down, to the spool bores in the valve housing.

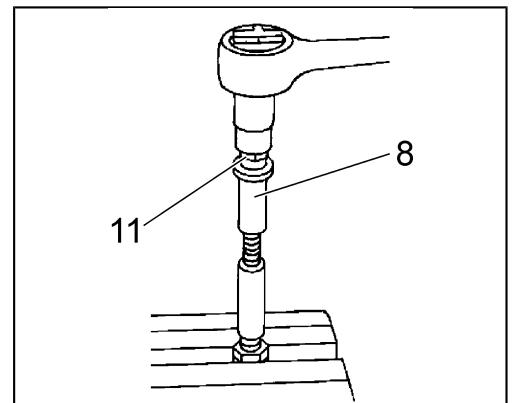


4. With the directional spool nutted in a vise, install the thrust washer (9).

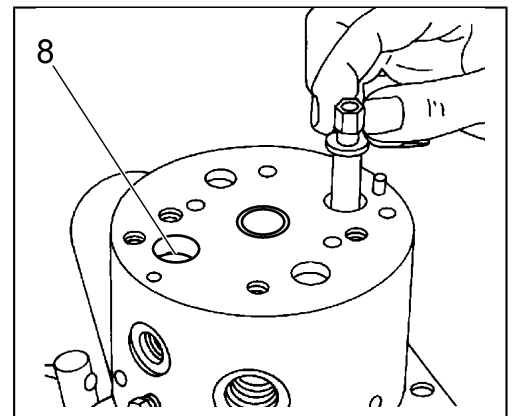


5. Apply LOCTITE #242 to the nut threads, and install the stop nuts (11). Torque the nuts to 22 [Nm].

Repeat Step 4 through 5 for remaining spool.



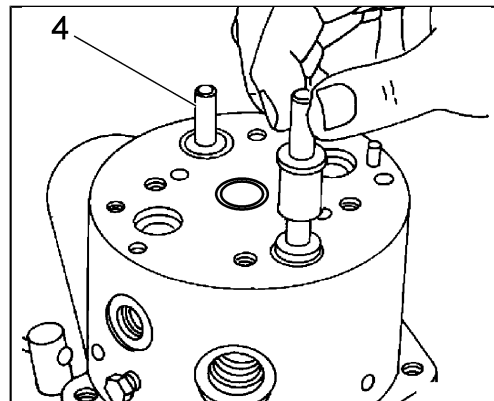
6. Install the directional spool (8) into the valve housing using a slight turning motion to aid the spool pass through the seal ring. Repeat for remaining spool. If removed, install dowel pin (17).



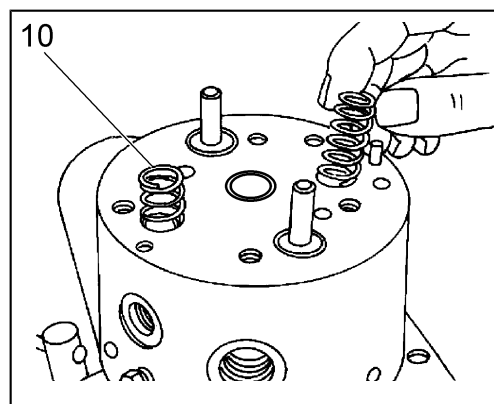
TRANSMISSION

DRIVE TRAIN CONTROL VALVE

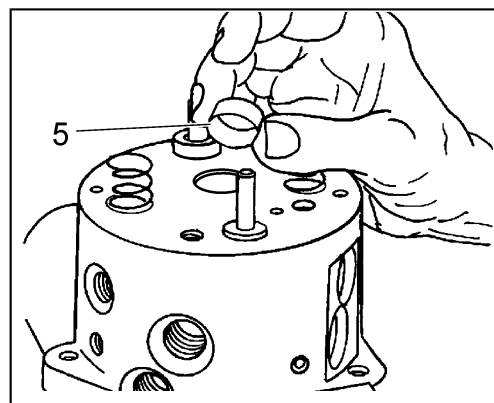
7. Install the steering spool (4) into the valve housing using a slight turning motion to aid the spool pass through the seal ring. Repeat for remaining spool.



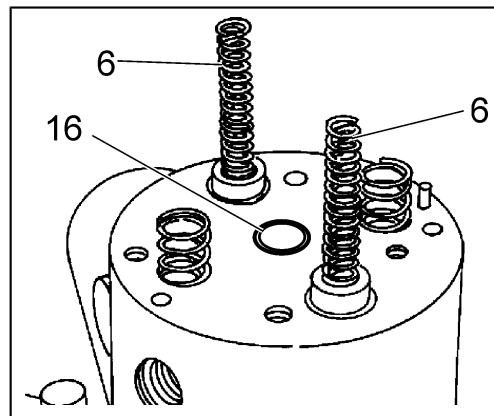
8. Install the directional spool springs (10) in the recessed bores.



9. Install the guide sleeves (5) over the steering spools with the recessed area towards the valve housing.

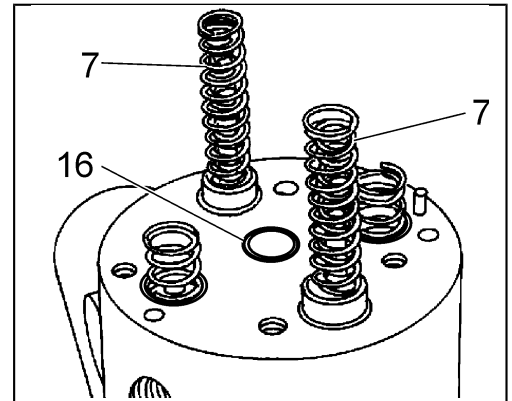


10. Install O-ring (16) into valve housing. Install the inner springs (6) to the steering spools.

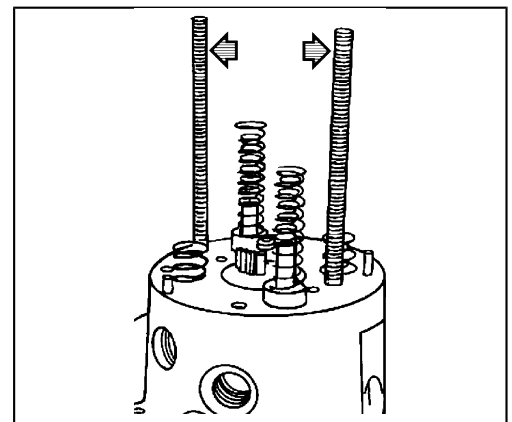


DRIVE TRAIN CONTROL VALVE

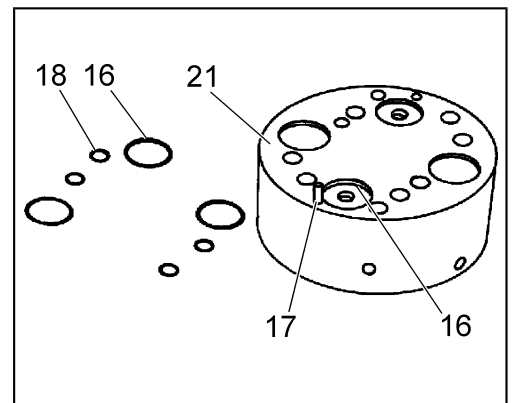
11. Install the outer springs (7) to the steering spools.



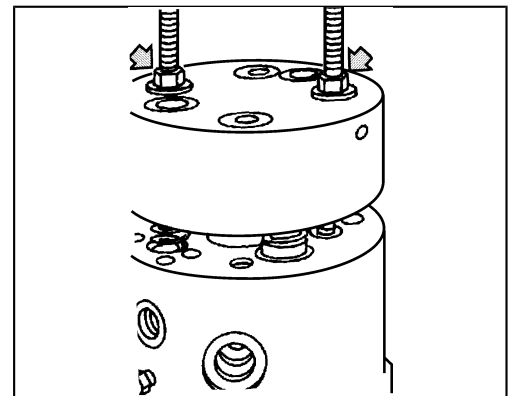
12. Install two threaded rods to valve housing.



13. Install new O-rings (16 and 18) to the bottom cover (21). If removed, install dowel pin (17).



14. Position the bottom cover (21) over the threaded rods, with the offset dowel pin holes to the dowel pins (17). Draw down equally on the nuts until the cover is flush.

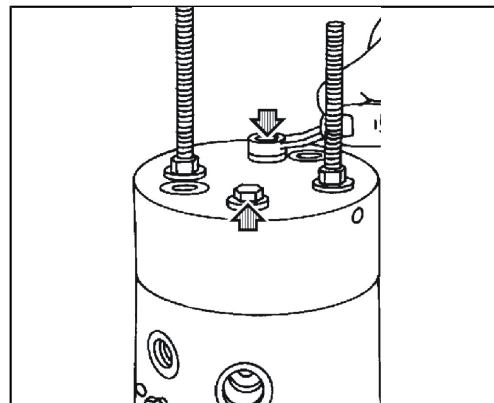


NOTE: Be careful not to bind the cover to the dowel pin.

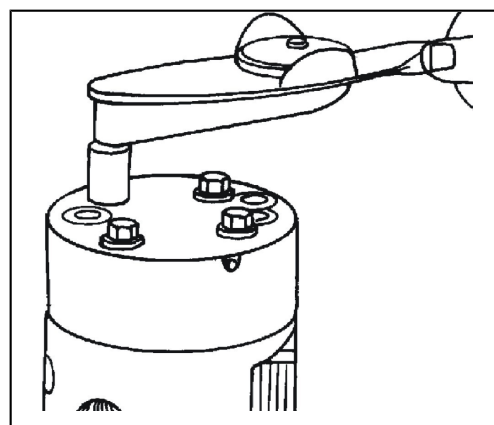
TRANSMISSION

DRIVE TRAIN CONTROL VALVE

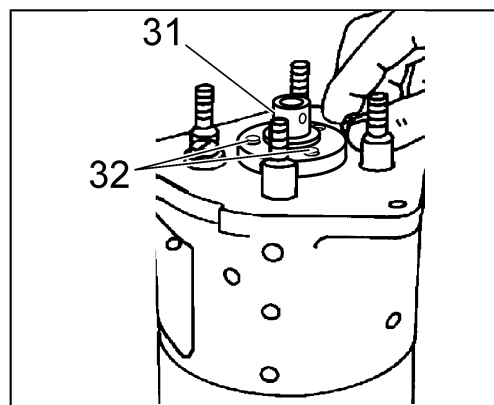
15. Install two mounting bolts at the open holes. Remove the threaded rods and install the remaining bolts.



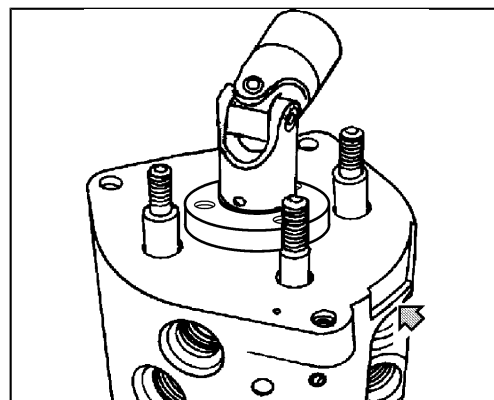
16. Torque the mounting bolts to 38 [Nm].



17. If removed, install two dowel pins (32). Install joint base (31) to the valve housing, aligning the base dowel pins with the offset recess in the valve housing. Torque the bolts to 11 [Nm].

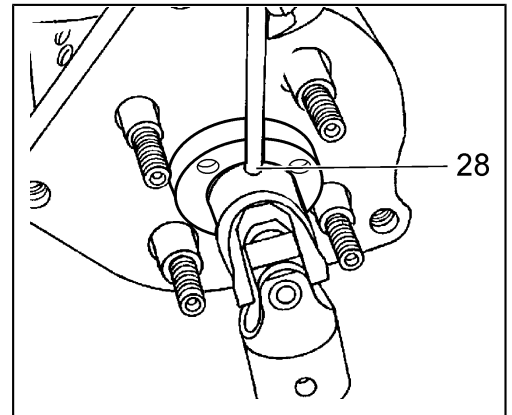


18. Slide the universal joint (27) over the joint base (31).

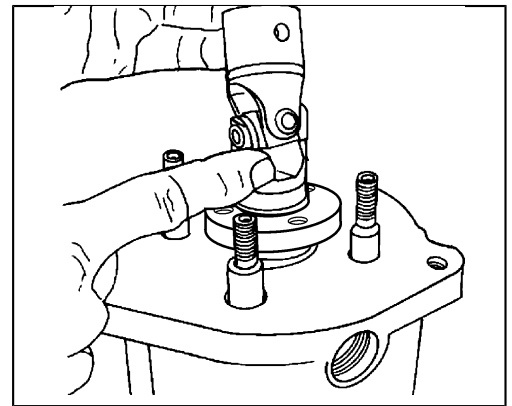


DRIVE TRAIN CONTROL VALVE

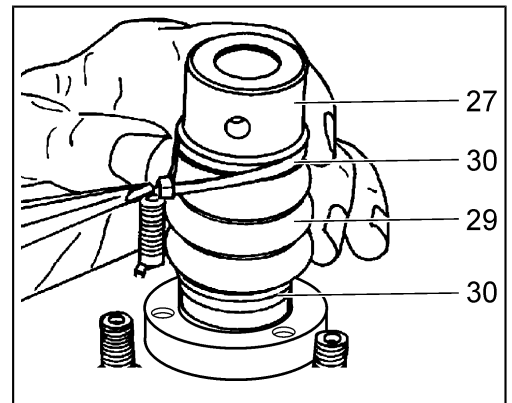
19. Drive the dowel pin (28) in making sure it is countersunk at each end.



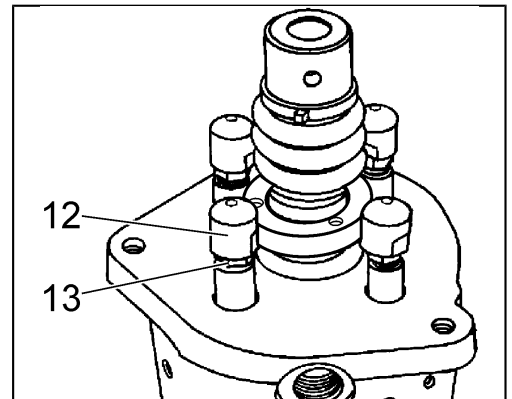
20. Apply a generous amount of grease (refer to OPERATOR'S MANUAL) to the universal joint.



21. Install the boot (29) over the universal joint (27) and secure with the tie straps (30).



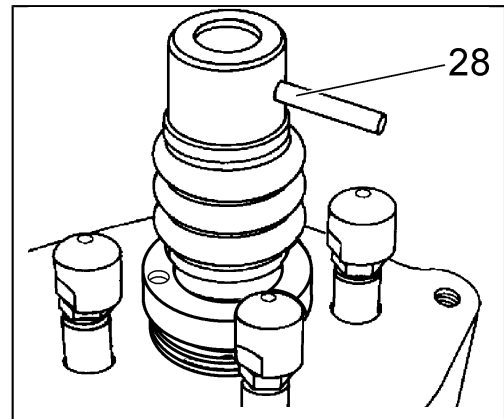
22. Install the jam nuts (13) and the spool rocker ends (12) to each spool.



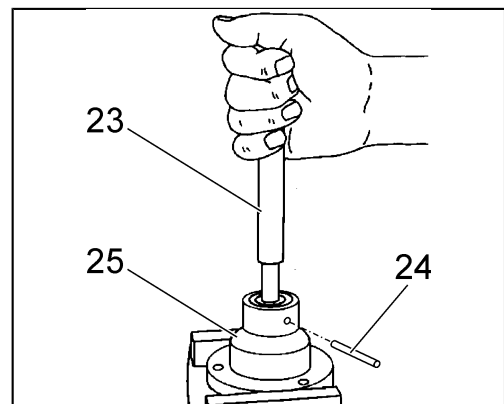
TRANSMISSION

DRIVE TRAIN CONTROL VALVE

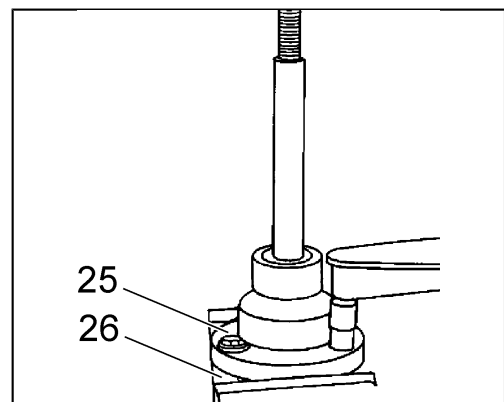
23. Start the dowel pin (28) into the universal joint.



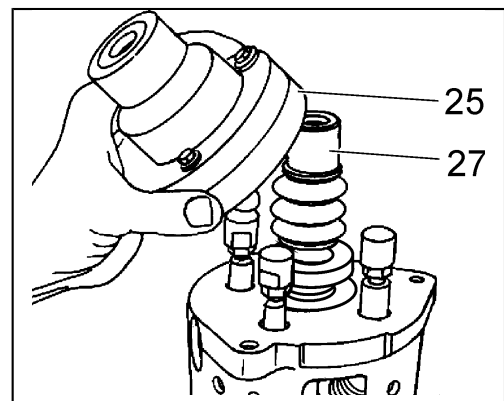
24. Install the lever (23) into the housing (25) and align with the dowel pin (24). Drive the pin into the housing so that it completely clears the housing.



25. Attach the joint housing (25) to the pivot ring (26) and torque the bolts to 11 [Nm].

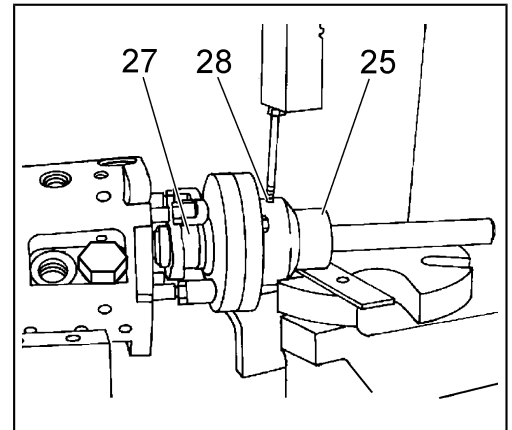


26. Install the joint housing (25) over the universal joint (27) and align the dowel pin opening in the universal joint with the opening in the joint housing.



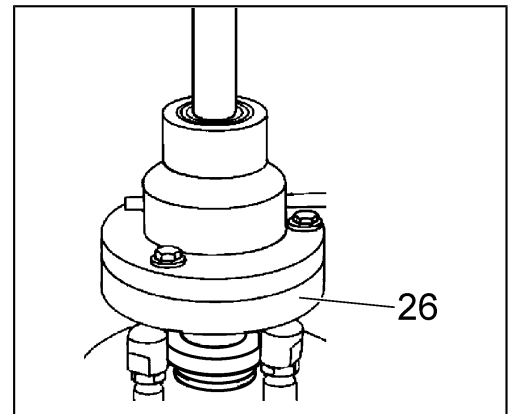
DRIVE TRAIN CONTROL VALVE

27. Drive the pin (28) into joint housing (25) to join the housing with the universal joint (27) so that it completely clears the housing (25).

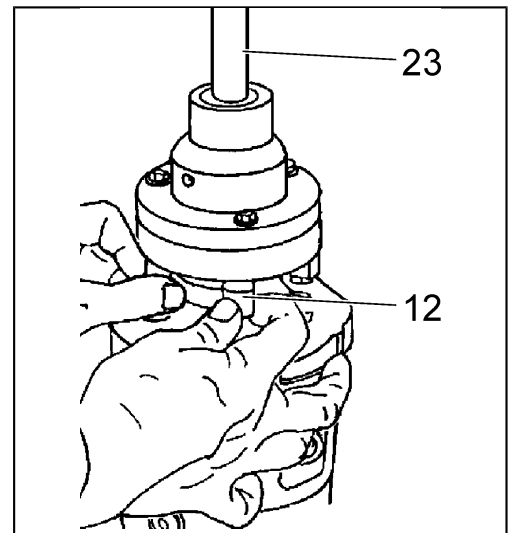


Drive Train Control Valve Adjustment

28. Apply a generous amount of grease (refer to OPERATOR'S MANUAL) to the pivot ring (26) surface.



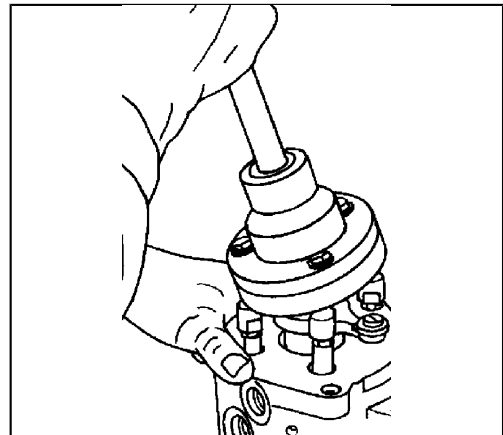
29. Run all four spool rocker ends (12) up against the pivot ring until the lever (23) is vertical with no free play between the pivot ring surface and rocker ends.



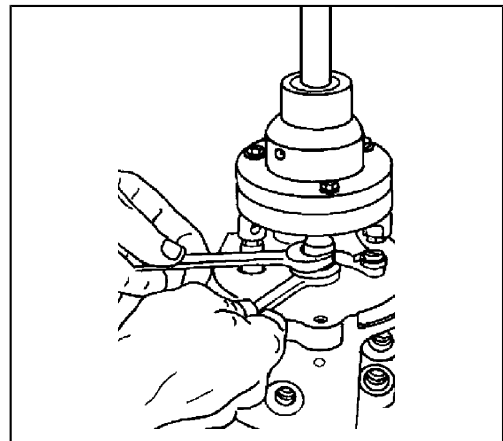
TRANSMISSION

DRIVE TRAIN CONTROL VALVE

30. Move the lever fully in all directions to seat the steering and directional spools against their springs. Recheck for free play between the pivot ring and rocker ends and correct as necessary.



31. Tighten the jam nuts to the spool rocker ends. Torque the nuts to 32 – 37 [Nm].



DRIVE TRAIN CONTROL VALVE

25. PRESSURE TEST

Drive train control valve pressure test. (Refer to Fig's. 7.1 and 7.2 in SECTION 7)

1. Install drive train control valve in the platform console as described in steps 1 to 7, INSTALLATION, under DRIVE TRAIN CONTROL VALVE in this Section.
2. Install Pressure Test Kit gauges (refer to SERVICE /SPECIAL TOOLS in Section 7, DRIVE TRAIN) in respective pressure lines.
3. Apply parking brake. Start the engine.
4. "FWD - RWD" pressure test.
 - a. Shift the drive train control lever from neutral (N) to forward (FWD) position. The hydraulic detent is to hold the lever within $7 [^\circ] \div 9 [^\circ]$; this hydraulic detent must be operational within $3 [^\circ] \div 5 [^\circ]$. The "F" test point pressure must be M-0.07 [MPa] and "R" test point pressure must be 0.0 [MPa]. Shift the lever back to the neutral position; the hydraulic detent must release the lever within $3.5 [^\circ] \div 6.5 [^\circ]$.
 - b. Repeat this procedure for the rearward (RWD) drive train control lever position. The pressures must be the same respectively.
 - c. The pressures in test points "F" and "R" must be 0.0 [MPa] for control lever in neutral (N) position.
5. Left and right steering pressure test (starting from neutral (N) position).
 - a. The pressures in test points "CR" and "CL" must be M-0.07 [MPa] for drive train control lever in neutral (N) position.
 - b. Gradually shift the lever from neutral (N) position to the right (RH) direction.
 - with the lever being shifted from $1.6 \pm 1 [^\circ]$ to $5.0 \pm 1 [^\circ]$ initially, the "CR" test point pressure in should be dropping gradually from M-0.07 [MPa] to 0.63 [MPa], followed by the pressure gradually drop to 0.35 [MPa] with lever shifted from $5.0 \pm 1 [^\circ]$ to $10.0 \pm 1 [^\circ]$.
 - finally the "CR" point pressure should be dropped gradually to 0.0 [MPa] with lever at the right extreme position. During this procedure the "CL" test point pressure must be M-0.07 [MPa].
 - c. Repeat this procedure for left (LH) direction. The "CL" point pressures should be identical as for RH direction respectively.
6. If the pressures are outside specified above, control valve should be repaired or replaced.
7. Shut off the engine and, in case of successful test pressure results, continue installation as described in INSTALLATION, under DRIVE TRAIN CONTROL VALVE in this Section.

TRANSMISSION

DRIVE TRAIN CONTROL VALVE

26. INSTALLATION

1. Install drive train control valve (4, Fig. 7C.74) into the valve bracket (2) and secure with three mounting bolts (3).
2. Put the valve bracket (2) with drive train control valve mounted into position, and install the assembly to the platform with four bolts (1).
3. Install valve console (3, Fig. 7C.72) into platform and secure with bolts (4).
4. Turn on control lever (5) with attached boot and electrical harness. Install two stiffener plates along with control lever.
5. Reconnect control lever harness (3, Fig. 7C.73).
6. Reconnect all hoses (1) to the drive train control valve (2).
7. Install filters bracket (1, Fig. 7C.71) with filters to the ROPS and secure with bolts (4). Reconnect the electrical harness to the filter base.
8. Reinstall cover (1, Fig. 7C.72) and secure with screws (2).



WARNING! Be sure the area around the machine is clear of personnel and obstructions as the vehicle may move during these test. If the machine starts to move, fully depress the decelerator pedal and shift the drive train control lever to NEUTRAL.

9. Apply parking brake. Start the engine. Move the drive train control lever through all the lever positions and check connections for leaks.
10. Install access cover (1, Fig. 7C.70) and secure with bolts (2).
11. Reinstall L.H. enclosure (3) on the left hand side and secure with bolts (4).
12. Check the oil level in the rear main frame as described in the OPERATOR'S MANUAL, add oil if required.

CHARGE AND COOLER PUMP**27. REMOVAL**

WARNING! Before working on a machine, be sure that the blade and ripper have been lowered to the ground, the engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and controls are tagged to prevent inadvertent engine starting.

IMPORTANT: When disconnecting hydraulic lines for any reason, they should be properly capped with correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt or lint into critical hydraulic components of machine. Tag all disconnect oil lines to facilitate easier installation.

1. Remove floor mat (cab equipped machines) and center floor plate from between instrument panel and operator's seat.
2. Remove the transmission case guard from the bottom of the machine.
3. Drain rear main frame as described in the OPERATOR'S MANUAL.
4. Disconnect breather hose (1, Fig. 7C.77) from the torque converter.



Fig. 7C.77. Charge and Cooler Pump Disconnecting Points

1. Breather Hose
2. Outlet Hose
3. Charge and Cooler Pump

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5. Disconnect two outlet hoses (2, Fig. 7C.77) from the top of pump (3).
6. Remove inlet „U” tube (1, Fig. 7C.78) from the bottom of charge and cooler pump (2).
7. Take up the slack in the hoist of pump and unscrew two mounting bolts. Pull the pump free of the torque converter and lower it out the bottom of the machine. Remove and discard the pump mounting O-ring.



Fig. 7C.78. View from under Machine on Charge and Cooler Pump

1. „U” Tube

2. Charge and Cooler Pump

28. DISASSEMBLY (Refer to Fig. 7C.79)

Troubleshooting procedures should be followed per instructions as described in SECTION 10A, PUMPS.

Charge and Cooler Pump

1. Clean unit thoroughly with a solvent and position pump assembly on bench. Mark covers and housings sections to ensure correct reassembly.
2. Remove screws (36) securing rear pump assy (22) to front pump assy (1). Separate pumps. Remove Oring (34).
3. Remove splined coupling (32) from the pump.

CHARGE AND COOLER PUMP

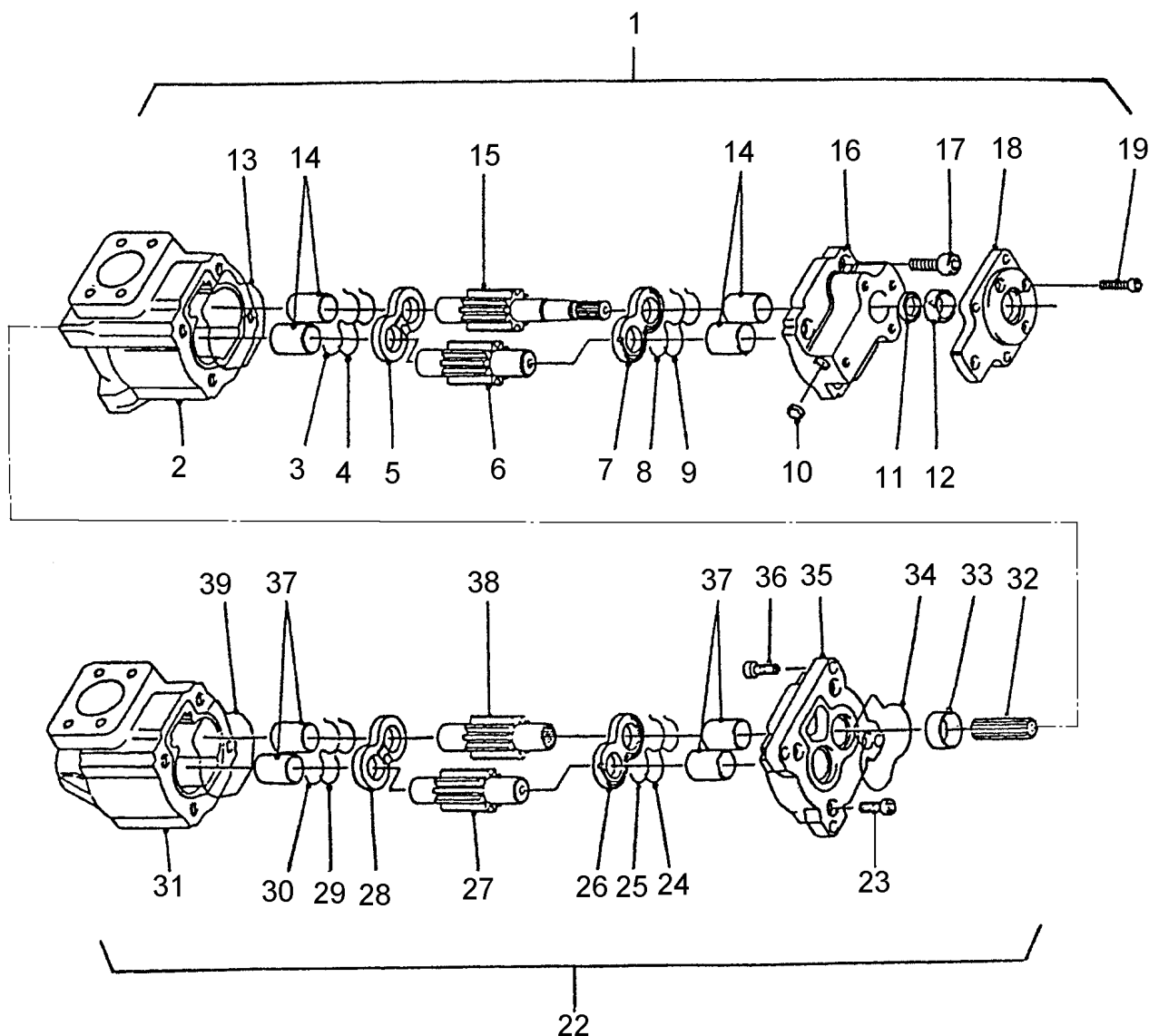


Fig. 7C.79. Exploded View of Charge and Cooler Pump

- | | | |
|----------------------|-------------------------|----------------------|
| 1. Front Pump Assy | 14. Bushings | 29. Wear Plate Seal |
| 2. Front Housing | 15. Front Drive Gear | 30. Back Up Ring |
| 3. Back Up Ring | 16. Front Cover | 31. Rear Housing |
| 4. Wear Plate Seal | 17. Main Fastener Screw | 32. Splined Coupling |
| 5. Wear Plate | 18. Mounting Flange | 33. Retainer Spacer |
| 6. Front Driven Gear | 19. Cap Screw | 34. O-Ring |
| 7. Wear Plate | 22. Rear Pump Assy | 35. Rear Cover |
| 8. Wear Plate Seal | 23. Main Fastener Screw | 36. Cap Screw |
| 9. Back Up Ring | 24. Back Up Ring | 37. Bushings |
| 10. Seal | 25. Wear Plate Seal | 38. Rear Drive Gear |
| 11. Seal Ring | 26. Wear Plate | 39. O-Ring |
| 12. Retainer Spacer | 27. Rear Driven Gear | |
| 13. O-Ring | 28. Wear Plate | |

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Front Pump Assy

4. Remove cap screws (19) and separate mounting flange (18) from front cover (16).
5. Remove retainer spacer (12) from mounting flange (18) with puller. Remove seal ring (11) from front cover (16). Remove seal (10) from front cover (16) if needed.
6. Remove main fasteners screw (17) and separate front cover (16) from front housing (2) by puller; or using copper hammer, taking care not to damage mating surfaces.

NOTE: *Never use screwdriver or other tools that may damage faying surfaces to separate front cover from housing.*

7. Remove O-ring (13). Remove wear plate (7) with seal (8) and back up ring (9). Remove front drive and driven gear set (6 and 15).

NOTE: *If gears are to be reused, they should be marked before removal to ensure replacement in same position – see Fig. 7C.80.*

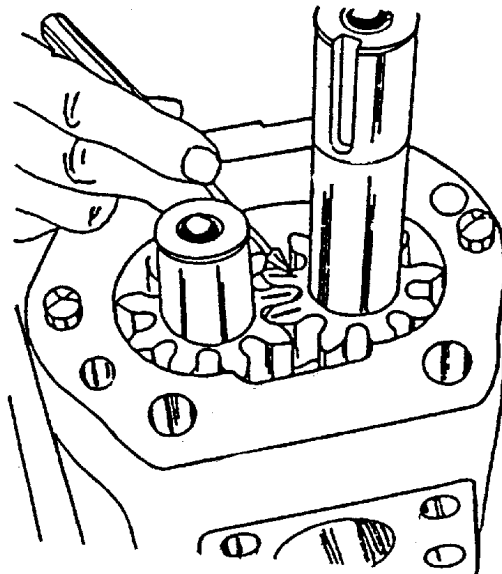


Fig. 7C.80. Marking Gears

8. Remove wear plate (5) with seal (4) and back up ring (3). Remove seals (4 and 8) and back up rings (3 and 9) from both wear plates (5 and 7).

NOTE: *Remove bushings (14) only in case it is necessary to replace them.*

9. Remove bushings (14) from front housing (2) and front cover (16) with bushing puller. Use extreme caution in removal of these parts to avoid damaging bore areas.
10. Remove retainer spacer (33) from front housing (2) with puller.

Rear Pump Assy

11. Remove main fasteners screws (23) and separate rear cover (35) from rear housing (31) by puller; or using copper hammer, taking care not to damage mating surfaces.

NOTE: *Never use screwdriver or other tools that may damage faying surfaces to separate rear cover from housing.*

CHARGE AND COOLER PUMP

12. Remove O-ring (39). Remove wear plate (26) with seal (25) and back up ring (24). Remove front drive and driven gear set (27 and 38).

NOTE: *If gears are to be reused, they should be marked before removal to ensure replacement in same position – see Fig. 7C.80.*

13. Remove wear plate (28) with seal (29) and back up ring (30). Remove seals (25 and 29) and back up rings (24 and 30) from both wear plates (26 and 28).

NOTE: *Remove bushings (37) only in case it is necessary to replace them.*

14. Remove bushings (37) from rear housing (31) and rear cover (35) with bushing puller. Use extreme caution in removal of these parts to avoid damaging bore areas.

29. INSPECTION AND REPAIR

1. In all cases, O-rings and seal components should be replaced. Following factors should be considered in determining reusability of a component.

NOTE: *Using fine stone remove irregularities on flat machined surface of housings (2 and 31) and covers (16 and 35).*

2. Discard wear plates that have score marks, heavy wear pattern or show erosion marks indicating cavitation or aerated oil condition. Refer to Fig. 7C.81.

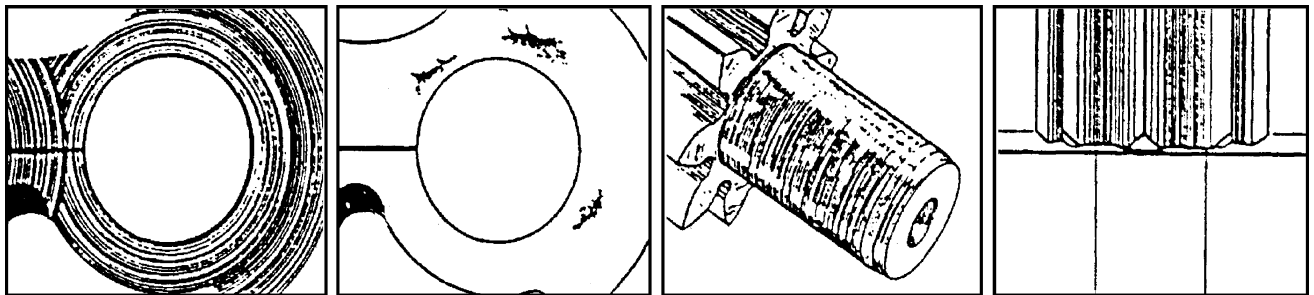


Fig. 7C.81. Pump Wear Plate Wear

Fig. 7C.82. Pump Gears Wear

3. Gear assemblies (refer to Fig. 7C.82) should be discarded if :
 - a. shaft journals show excessive wear or pitting,
 - b. gear teeth show excessive wear,
 - c. gear face scored or cracked,
 - d. drive shaft splines or key ways distorted or badly worn

NOTE: *Gears assemblies must be replaced in pairs.*

4. Replace sliding bushings (14 and 37) if worn or damaged, or if gears assemblies have been replaced.

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CHARGE AND COOLER PUMP

30. REASSEMBLY (Refer to Fig. 7C.79)

Rear Pump Assy

NOTE: Lubricate all component parts with the same oil as used in transmission system during reassembly of the pump.

1. If removed, press bushings (37) into rear pump housing (31) and into rear pump cover (35) in accordance with previous identification. Use mallet for this procedure.

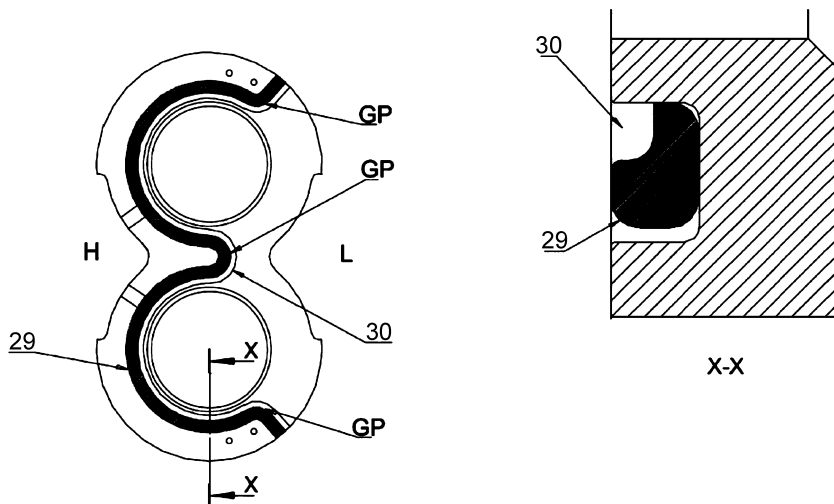


Fig. 7C.83. Moulded Back Up Ring with Seal Type Wear Plate

29 - Wear Plate Seal

30 - Back Up Ring

H - High Pressure Outlet,

L - Low Pressure Inlet

GP - Grease Point

2. Assembly the wear plate (28) so that seal (29) and back up ring (30) must be adjacent to the wear plate (28) face and body, as shown in Fig. 7C.83.
 - a. Apply grease to the three positions (GP) shown on Fig. 7C.83 before inserting the seals in position.
 - b. Fit the wear plate seal (29) into the wear plate groove with the flat face at the bottom of the seal groove as shown on Fig. 7C.83.
 - c. Fit the back up ring (30) into the recess in the top of the wear plate seal (29), with the radiused edges and "legs" of the back up face downwards.

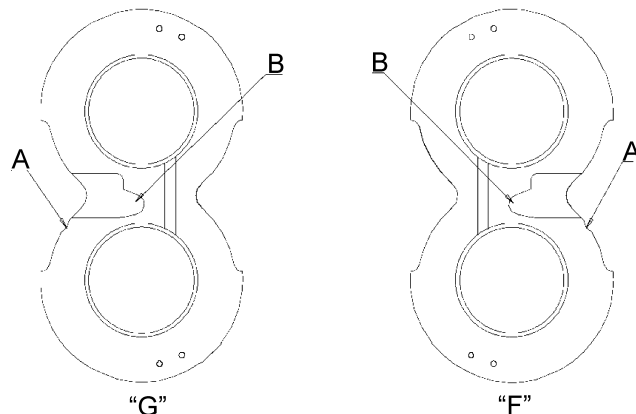


Fig. 7C.84. Type G and F Wear Plates

A - Relief Slot Marker

B - Pressure Relief Slot

CHARGE AND COOLER PUMP

NOTE: There are two types of wear plate: Type F and G shown in Fig. 7C.84. The main differences between the two types is the handing of the pressure relief slot. The high pressure side of wear plate, marked H on drawings, must be adjacent to the outlet port.

3. Insert the wear plate (28) type G into rear pump housing (31) first. The back up ring (30) must be installed face down, ensuring that the high pressure side of the wear plate (28) is adjacent to outlet port, and with the relief slot positioned as shown in Fig. 7C.85.

NOTE: When assembling wear plate into the pump, ensure seal and backup remain in position at all times until fully seated in position. If seal and back up ring come out of seal groove, wear plate must be removed, and reassembled.

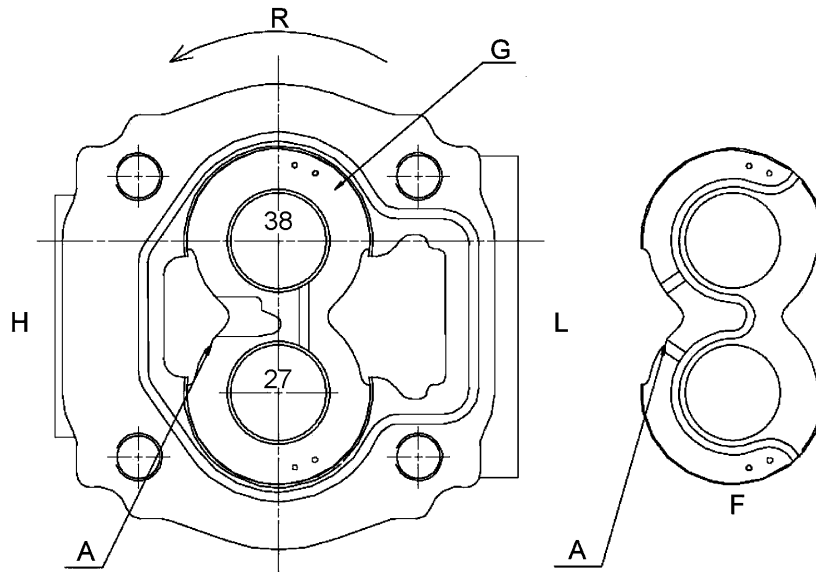


Fig. 7C.85. Wear Plate Assembly (Anti-clockwise Rotation)

27 – Rear Driven Gear	G – Wear Plate Type G
38 – Rear Drive Gear	H – High Pressure Outlet
A – Relief Slot Marker	L – Low Pressure Inlet
F – Wear Plate Type F	R – Rotation

4. Fit rear drive gear (38) first, ensuring correct orientation. Lightly lubricate gear flanks, faces and journals prior to assembly.
5. Fit rear driven gear (27) in position in accordance with previous match marking, ensuring that both gears (27 and 38), once assembled, are level to each other. If not, remove both gears and check whether wear plate (28) is seating correctly then re-fit gears (27 and 38).
6. When both gears have been installed, fit the second wear plate (26), type F, assembled according to Step 2 in this Paragraph. The second wear plate (26) must be installed over gears (27 and 38) so that the back up ring (24) is face up and again with the high pressure side (H) adjacent to the outlet port, and with the relief slot in line with the first wear plate (28). When assembled with gears (27 and 38) in position, the relief slot marker (A) on both wear plates (28 and 26) should be in line with each other, refer to Fig. 7C.85.

NOTE: The wear plate must not be assembled so that the back up ring is on the gear side.

7. Position interface O-ring (39) into groove of rear housing (31), ensuring that it is seating fully down in groove before rear cover (35) can be fitted.

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8. Fit rear cover (35) in position and loosely fit main fasteners screws (23). Torque screws in order shown in Fig. 7C.86 in two stages. Torque the four screws in crosswise order to 50% of full torque value first, i.e. $180 \pm 5\%$ [Nm]. Then tighten the fasteners to full torque of $360 \pm 5\%$ [Nm] in the same order.

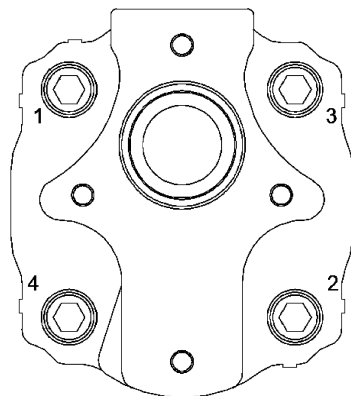


Fig. 7C.86. Screw Tightening Order

1, 2, 3, 4 – Main Fasteners Screws

Front Pump Assy

9. If removed, press bushings (14) into front pump housing (2) and into front pump cover (16) in accordance with previous identification. Use mallet for this procedure. If not fitted, fit seal (10) into cover (16).
10. Assembly the wear plate (5) so that seal (4) and back up ring (3) must be adjacent to the wear plate (5) face and body. Refer to Fig. 7C.87.
- Apply grease to the three positions (GP) shown on Fig. 7C.83 before inserting the seals in position.
 - Fit the wear plate seal (29) into the wear plate groove with the flat face at the bottom of the seal groove as shown on Fig. 7C.83.
 - Fit the back up ring (30) into the recess in the top of the wear plate seal (29), with the radiused edges and “legs” of the back up face downwards.

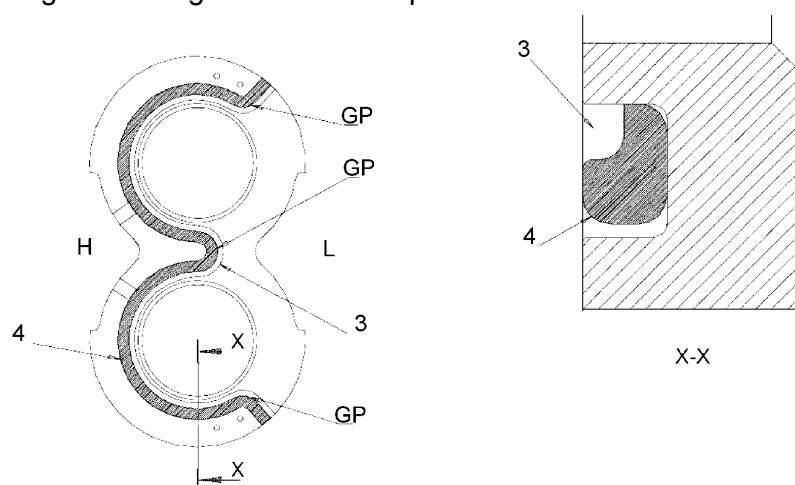


Fig. 7C.87. Moulded Back Up Ring with Seal Type Wear Plate

3 - Back Up Ring
4 - Wear Plate Seal

H - High Pressure Outlet
L - Low Pressure Inlet

GP - Grease Point

CHARGE AND COOLER PUMP

NOTE: There are two types of wear plate: Type F and G shown in Fig. 7C.84. The main differences between the two types is the handing of the pressure relief slot. The high pressure side of wear plate, marked H on drawings, must be adjacent to the outlet port.

11. Insert the wear plate (5) type G into front pump housing (2) first. The back up ring (3) must be installed face down, ensuring that the high pressure side of the wear plate (5) is adjacent to outlet port, and with the relief slot positioned as shown in Fig. 7C.85.

NOTE: When assembling wear plate into the pump, ensure seal and backup remain in position at all times until fully seated in position. If seal and back up ring come out of seal groove, wear plate must be removed , and reassembled.

12. Fit front drive gear (15) first, ensuring correct orientation. Lightly lubricate gear flanks, faces and journals prior to assembly.
13. Fit front driven gear (6) in position in accordance with previous match marking, ensuring that both gears (6 and 15), once assembled, are level to each other. If not, remove both gears and check whether wear plate (5) is seating correctly then re-fit gears (6 and 15).
14. When both gears have been installed, fit the second wear plate (7), type F, assembled according to Step 2 in this Paragraph. The second wear plate (7) must be installed over gears (6 and 15) so that the back up ring (9) is face up and again with the high pressure side (H) adjacent to the outlet port, and with the relief slot in line with the first wear plate (5). When assembled with gears (6 and 15) in position, the relief slot marker (A) on both wear plates (5 and 7) should be in line with each other, refer to Fig. 7C.85.

NOTE: The wear plate must not be assembled so that the back up ring is on the gear side.

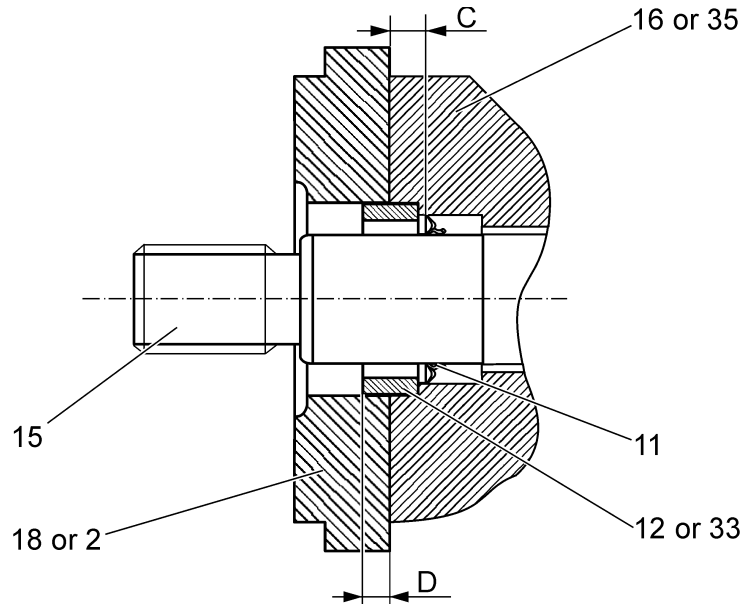


Fig. 7C.88. Assembly Dimensions of Seal Rings and Retainer Spacers

2. Front Housing
11. Seal Ring
12. Retainer Spacer
15. Front Drive Gear

16. Front Cover
18. Mounting Flange
33. Retainer Spacer
35. Rear Cover

C - Seal Rings Assembly Dimension
D - Retainer Spacer Assembly Dimension

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CHARGE AND COOLER PUMP

15. Position interface O-ring (13) into groove of front housing (2), ensuring that it is seating fully down in groove before front cover (16) can be fitted.
16. Fit front cover (16) in position and loosely fit main fasteners screws (17). Torque screws in order shown in Fig. 7C.86 in two stages. Torque the four main fasteners (17) in crosswise order to 50% of full torque value first, i.e. $180 \pm 5\%$ [Nm]. Then tighten the main fasteners to full torque of $360 \pm 5\%$ [Nm] in the same order.
17. Fit seal ring (11) into front cover (16) using insertion tool (9104-M-328-1) maintaining C dimension; $C = 8.5$ [mm] as shown in Fig. 7C.88. Apply a thin coat of "ALVANIA" grease plus Molybdenum Disulphide (MoS_2) to the seal ring (11) to prevent burning during the bedding in period. Apply grease to the outer seal lip only.

NOTE: *It is essential that only a light thin coating of grease be applied, so that any leak can be detected.*

18. Insert retainer spacer (12) into mounting flange (18) using insertion tool (9104-M-329-1) maintaining D dimension; $D = 6.5$ [mm] as shown in Fig. 7C.88.
19. Apply a continuous bead ($1 \div 1.5$ [mm] dia.) of LOCTITE #573 sealant (or commercial equivalent) as shown in Fig. 7C.89, to mating surface of front cover (16), approx. 10 [mm] from retainer spacer (12).
20. Attach mounting flange (18) to front cover (16) and loosely fit with cap screws (19). Torque screws in order shown in Fig. 7C.86 in two stages. Torque the four screws in crosswise order to 50% of full torque value first, i.e. $44 \pm 5\%$ [Nm]. Then tighten the screws to full torque of $88 \pm 5\%$ [Nm] in the same order.

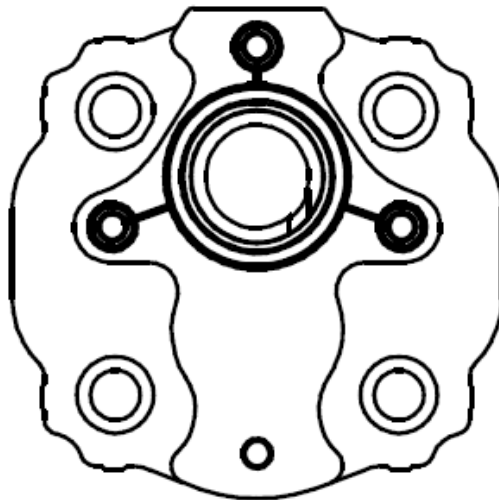


Fig. 7C.89. LOCTITE Applying Procedure

CHARGE AND COOLER PUMP

Charge and Cooler Pump

21. Insert retainer spacer (33) into front pump assy housing (2) rear side using insertion tool (9104-M-329-1) maintaining D dimension; $D = 6.5$ [mm] as shown in Fig. 7C.88.
22. Fit splined coupling (32) into rear drive gear (38) opening.
23. Position interface O-ring (34) into groove of front rear cover (35), ensuring that it is seating fully down in groove before front pump assy (1) can be fitted.
24. Fit front pump assy (1) to rear pump assy (22) and loosely fit with cap screws (36). Torque the screws in order shown in Fig. 7C.86 in two stages. Torque the four screws in crosswise order to 50% of full torque value first, i.e. $44 \pm 5\%$ [Nm]. Then tight the screws to full torque of $88 \pm 5\%$ [Nm] in the same order.
25. Check by hand that front drive gear (15) rotates freely.

31. INSTALLATION

IMPORTANT: Before installation remove all plastic caps or rubber plugs if used before.

1. Thoroughly clean the mating surfaces of the torque converter housing and the charge and cooler pump housing.
2. Install a new O-ring on the pump housing flange.

IMPORTANT: As the charge and cooler pump housing enters the torque converter housing, be sure the O-ring is properly seated in the groove of the pump housing.

3. Attach a suitable sling to charge and cooler pump. The sling must be installed to give the best possible balance. Position the charge and cooler pump (3) with new mounting O-ring on the torque converter flange as shown on Fig. 7C.77. Install pump assembly into torque converter aligning pump shaft splines with converter drive gear. Using mounting hardware secure the pump to torque converter. Torque mounting bolts to $180 \pm 10\%$ [Nm].
4. Reconnect two outlet hoses (2) to the top of pump (3).
5. Reconnect inlet „U” tube (1, Fig. 7C.78) to the bottom of charge and cooler pump (2).
6. Reconnect breather hose (1, Fig. 7C.77) to the torque converter.
7. Refill the main frame as described in the OPERATOR'S MANUAL.
8. Start the engine and check for leaks.
9. Check the rear main frame oil level as described in the OPERATOR'S MANUAL and add if necessary.
10. Install the transmission case guard to the bottom of machine.
11. Install the center floor plate between seat and instrument panel. Install the floor mat, if cab equipped.

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GEAR SHIFTING VALVE

32. REMOVAL (Refer to Fig. 7C.90)



WARNING! Before working on a machine, be sure that the blade and ripper have been lowered to the ground, the engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and controls are tagged to prevent inadvertent engine starting.

IMPORTANT: Disconnected hydraulic lines must be properly capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Remove all dirt accumulation from the main frame cover. Tag disconnected lines to facilitate faster and correct installation.

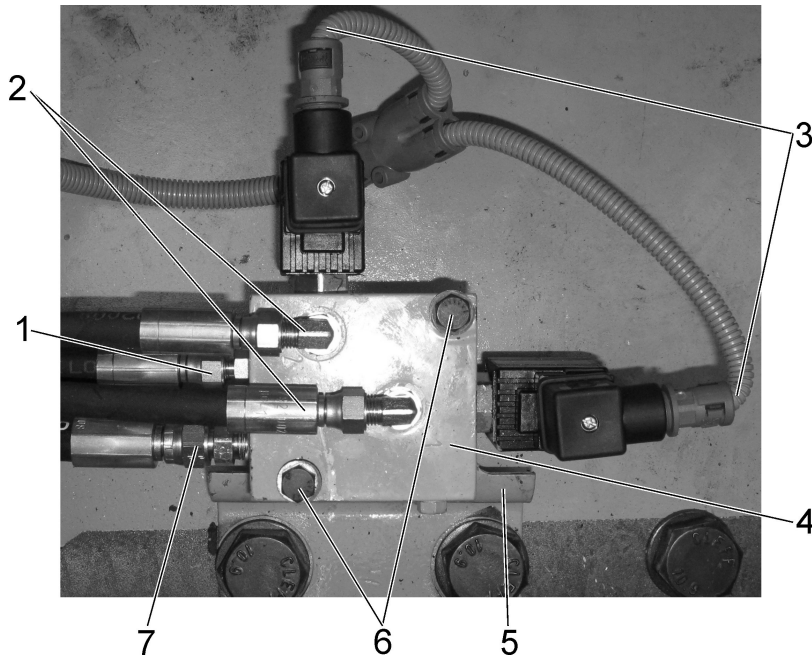


Fig. 7C.90. Gear Shifting Valve Disconnect Points

- | | |
|------------------------|-------------------------|
| 1. Drain Hose | 5. Bracket |
| 2. Control Hoses | 6. Bolts |
| 3. Wiring Harnesses | 7. Pressure Supply Hose |
| 4. Gear Shifting Valve | |

1. Unscrew bolts (1, Fig. 7E.1) securing rear platform (2) and remove the platform from the machine.
2. Disconnect wiring harnesses (3) at two solenoids.
3. Disconnect two control hoses (2).
4. Unscrew two bolts (6) and separate gear shifting valve (4) from the bracket (5).
5. Disconnect drain hose (1) and pressure supply hose (7) and remove the valve out of machine.

GEAR SHIFTING VALVE

33. DISASSEMBLY (Refer to Fig. 7C.85)

1. Unscrew the solenoid coils from the solenoid valves (1 and 2). Remove the solenoid valve (1 and 2) bodies from the valve housing (3). Remove and discard the valve seal kit and replace with new.
2. Remove plug (4), if necessary.

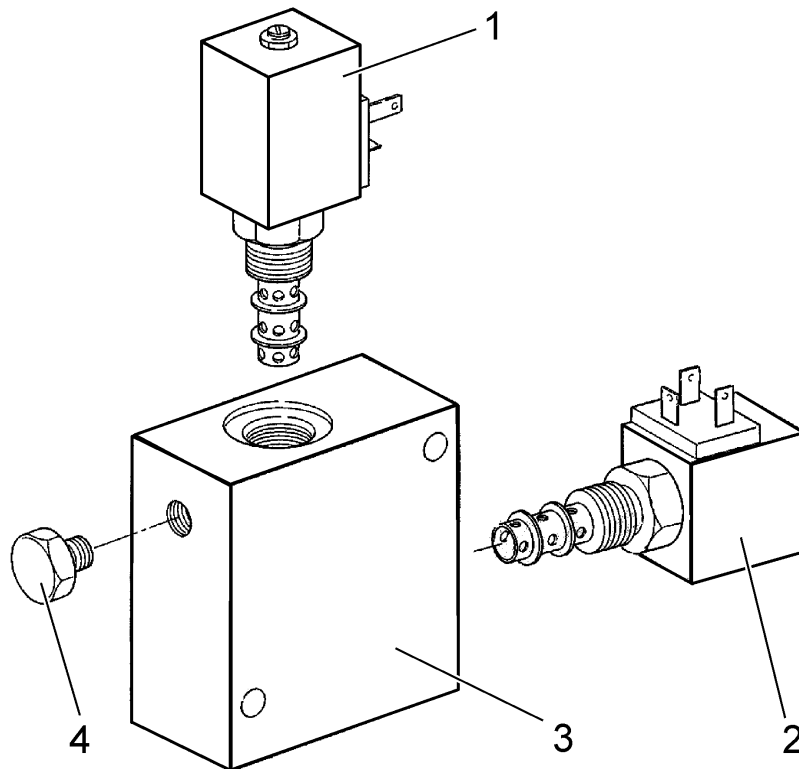


Fig. 7C.91. Exploded View of Gear Shifting Valve

- | | |
|--|------------------|
| 1. Solenoid Valve 3 rd Gear | 3. Valve Housing |
| 2. Solenoid Valve 2 nd Gear | 4. Plug |

34. INSPECTION AND REPAIR

1. It is recommended that all new O-rings and seal rings be installed upon reassembly of the valve.
2. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all oil passages in the valve bodies and spools are free of obstructions.
3. Inspect parts for excessive wear and replace if necessary.
4. Clean threads with a stiff brush and solvent. Check for damage.

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GEAR SHIFTING VALVE

35. REASSEMBLY (Refer to Fig. 7C.91)

1. Apply LOCTITE PIPE SEALANT to the threads of plug (4) and install it, if removed.
2. Install a new seal kit to the solenoid valve (1 and 2) bodies. Install the solenoid valves bodies to the valve housing (3). Torque the solenoid valve (1 and 2) bodies to 20.5 – 22.5 [Nm]. Install the solenoid coils on valve bodies and torque them to 4.3 – 4.8 [Nm].

36. INSTALLATION (Refer to Fig. 7C.90)

1. Temporarily secure the gear shifting valve (4) to the valve bracket (5). Reconnect the pressure supply hose (7) and drain hose (1) to the valve and then install the gear shifting valve (4) to the bracket (5) with two mounting bolts (6).
2. Reconnect two control hoses (2) to the valve housing.
3. Reconnect two wiring harnesses (3) to the solenoids.
4. Start the engine and operate with drive train control lever. Check for leaks and functioning.
5. Reinstall the rear platform (2, Fig. 7E.1).

PRIORITY VALVE**37. REMOVAL AND DISASSEMBLY**

WARNING! Before working on a machine, be sure that the blade and ripper have been lowered to the ground, the engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and controls are tagged to prevent inadvertent engine starting.

IMPORTANT: Disconnected hydraulic lines must be properly capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Remove all dirt accumulation from the main frame cover. Tag disconnected lines to facilitate faster and correct installation.

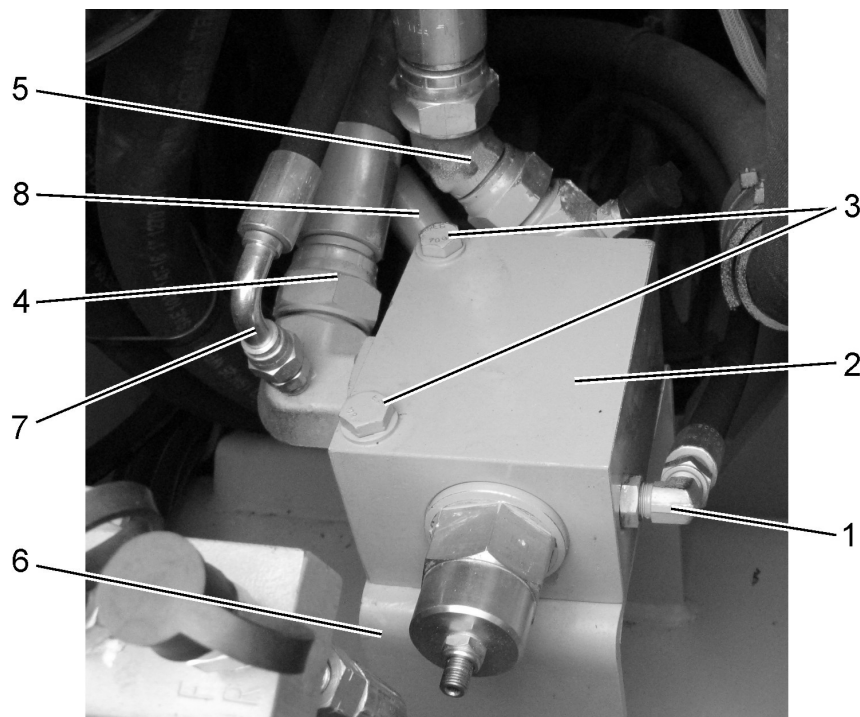


Fig. 7C.92. Priority Valve Disconnect Points

- | | |
|--|-------------------------|
| 1. Drain Hose | 5. Pressure Supply Hose |
| 2. Priority Valve | 6. Bracket |
| 3. Mounting Bolt | 7. Hose |
| 4. Priority Valve to Transmission Hose | 8. Hose |

1. Open LH filter compartment door.
2. Disconnect supply hose (5, Fig. 7C.92) and hose (8) from the priority valve (2).
3. Unscrew two bolts (3) and separate priority valve (2) from LH fender bracket (6).
4. Disconnect drain hose (1), hose (7) and priority valve to transmission hose (4) from the priority valve (2).
5. Lift the valve from the machine and remove attached hydraulic connectors, if necessary.
6. Remove the pressure regulator (1, Fig. 7C.93) from the valve housing (2). Remove and discard the valve seal kit and replace with new.

TRANSMISSION

PRIORITY VALVE

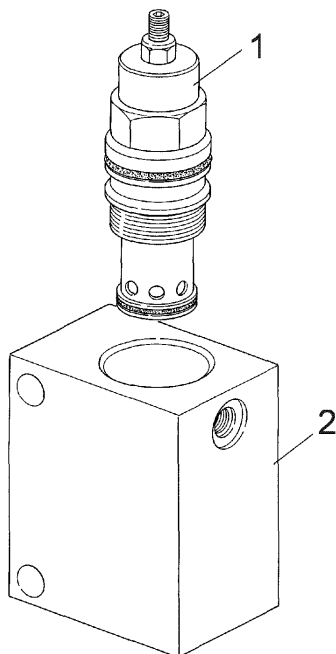


Fig. 7C.93. Exploded View of Priority Valve

- 1. Pressure Regulator
- 2. Valve Housing

38. INSPECTION AND REPAIR

1. It is recommended that all new seal rings be installed upon reassembly of the valve.
2. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all oil passages in the valve housing and regulator are free of obstructions.
3. Inspect parts for excessive wear and replace if necessary.
4. Clean threads with a stiff brush and solvent. Check for damage.

39. REASSEMBLY AND INSTALLATION

1. Install a new seal kit to the pressure regulator body (1, Fig. 7C.93).
2. Install the pressure regulator into the valve housing (2). Torque the regulator body (1) to $465 \div 500$ [Nm].
3. Reconnect the priority valve to transmission hose (4, Fig. 7C.92), hose (7) and drain hose (1) to the valve (2).
4. Secure the priority valve (2, Fig. 7C.92) to the LH fender bracket (6) with two mounting bolts (3) and support bar.
5. Reconnect remaining pressure supply hose (5) and hose (8) to the valve (2).
6. Start the engine and operate with drive train control lever. Check for leaks and functioning.
7. Check the priority valve pressure and adjust, if necessary. Refer to PRIORITY VALVE PRESSURE CHECK AND ADJUSTMENT PROCEDURE in SECTION 7, DRIVE TRAIN.
8. Shut off the engine and close LH filter compartment door.

DRIVE TRAIN LOCK SOLENOID VALVE**40. REMOVAL AND DISASSEMBLY**

WARNING! Before working on a machine, be sure that the blade and ripper have been lowered to the ground, the engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and controls are tagged to prevent inadvertent engine starting.

IMPORTANT: Disconnected hydraulic lines must be properly capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Remove all dirt accumulation from the main frame cover. Tag disconnected lines to facilitate faster and correct installation.

1. Unscrew bolts (4, Fig. 7C.94) and remove L.H. enclosure (3) with L.H. door.
2. Disconnect the electrical harness from the filter base (3, Fig. 7C.95). Unscrew bolts (4) mounting filters bracket (1) to ROPS bracket and allow the bracket (1) with filters (2) to be supported by the hoses.
3. Unscrew bolts (2, Fig. 7C.94) and remove access cover (1) in order to obtain access to mounting points of the drive train lock solenoid valve.

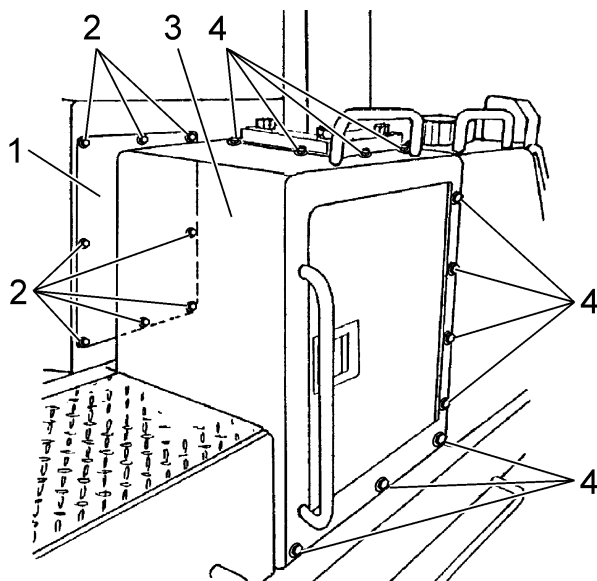


Fig. 7C.94. Disassembly Access Cover to Drive Train Control Valve

1. Access Cover
2. Bolts
3. L.H. Enclosure
4. Bolts

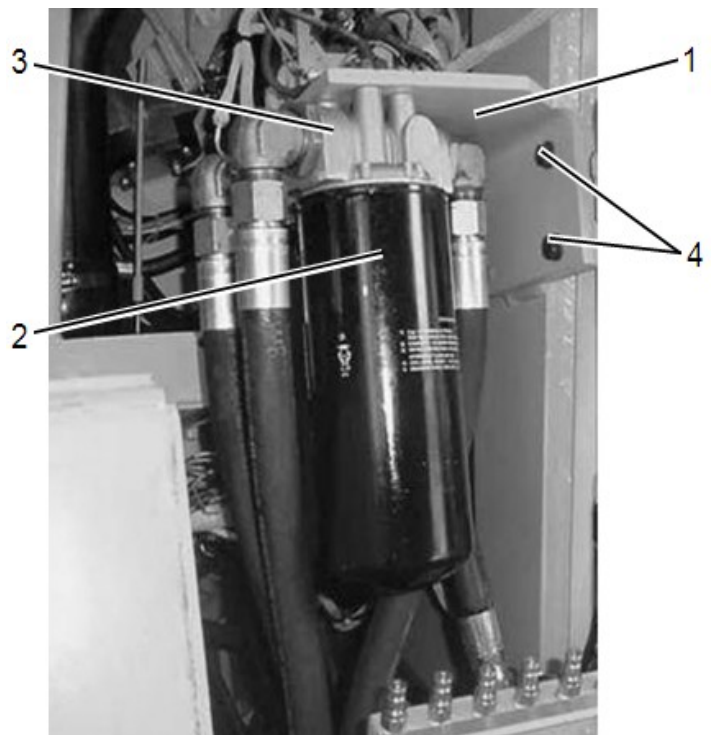


Fig. 7C.95. Drive Train Pressure Filters Removal

1. Filter Bracket
2. Filter
3. Filter Base
4. Bolts

TRANSMISSION

DRIVE TRAIN LOCK SOLENOID VALVE

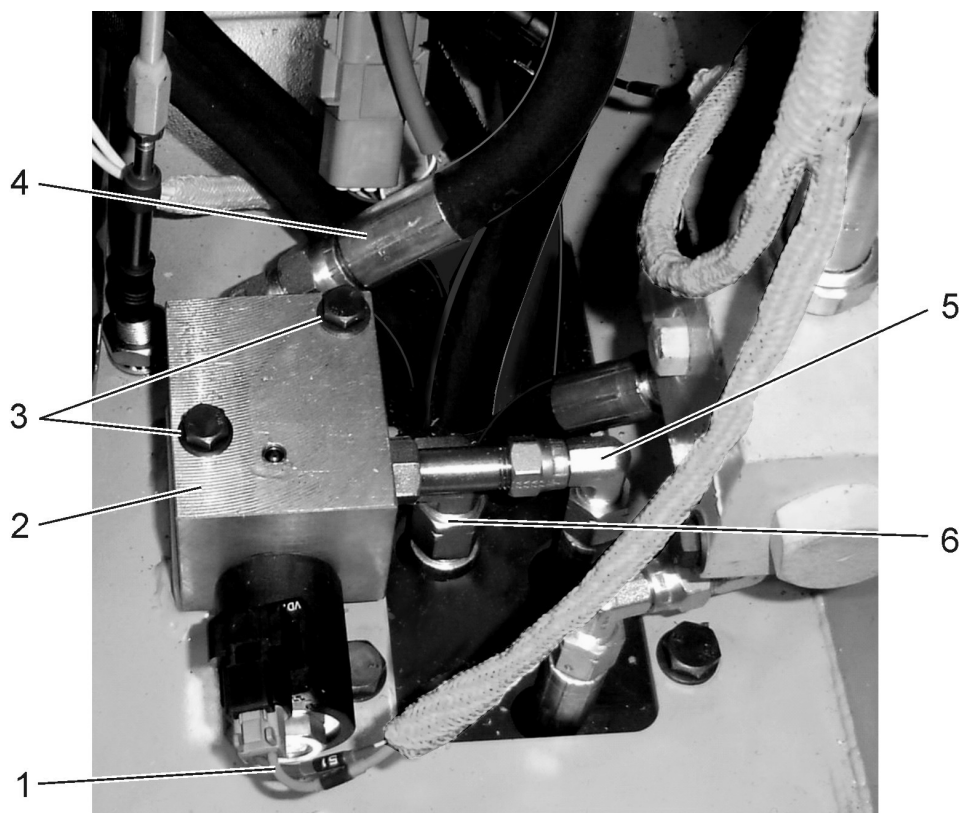


Fig. 7C.96. Drive Train Lock Solenoid Valve Disconnect Points

1. Harness
2. Drive Train Lock Solenoid Valve
3. Mounting Bolts
4. Solenoid Lock Valve to Drive Train Control Valve Hose
5. Drain Hose
6. Pressure Supply Hose

4. Disconnect drive train lock solenoid valve harness (1, Fig. 7C.96).
5. Disconnect drain hose (5), supply hose (6) and lock solenoid valve to drive train control valve hose (4) from the lock solenoid valve (2).
6. Unscrew two bolts (3) and separate lock solenoid valve (2) from LH fender.
7. Lift the valve from the machine and remove attached hydraulic connectors, if necessary.
8. Unscrew the solenoid coil from the lock solenoid valve (2, Fig. 7C.97). Remove the solenoid valve cartridge from the valve manifold (1). Remove and discard the valve seal kit and replace with new.
9. Remove plug (3), if necessary.

DRIVE TRAIN LOCK SOLENOID VALVE

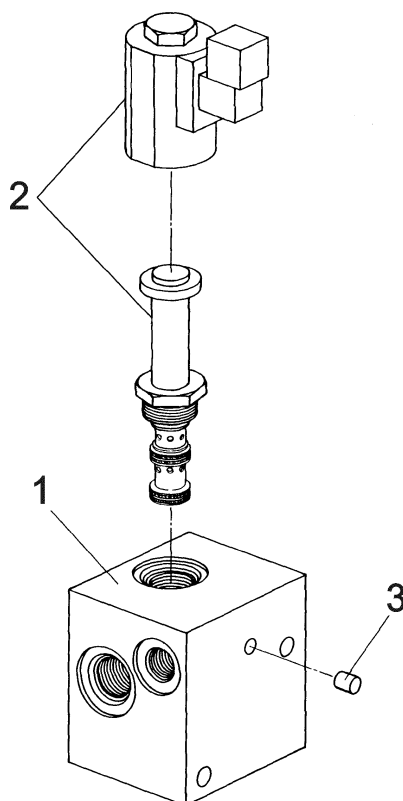


Fig. 7C.97. Explode View of Drive Train Lock Solenoid Valve

- 1. Manifold
- 2. Solenoid Valve
- 3. Port Plug

41. INSPECTION AND REPAIR

1. It is recommended that all new seal rings be installed upon reassembly of the valve.
2. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all oil passages in the valve manifold and valve cartridge are free of obstructions.
3. Inspect parts for excessive wear and replace if necessary.
4. Clean threads with a stiff brush and solvent. Check for damage.

TRANSMISSION

DRIVE TRAIN LOCK SOLENOID VALVE

42. REASSEMBLY AND INSTALLATION

1. Apply LOCTITE #592 PIPE SEALANT to the threads of plug (3, Fig. 7C.97) and install, if removed.
2. Install a new seal kit to the solenoid valve cartridge (2) Install valve cartridge to the valve manifold (1). Torque the cartridge to 40 [Nm]. Install the solenoid coil on valve cartridge and torque the nut to $5.4 \div 8.1$ [Nm].
3. Secure the lock solenoid valve (2, Fig. 7C.96) to the LH fender with two mounting bolts (3).
4. Reconnect hose (4), pressure supply hose (6) and drain hose (5) to the lock solenoid valve (2).
5. Reconnect lock solenoid valve harness (1) to the valve (2).



WARNING! Be sure the area around the machine is clear of personnel and obstructions as the vehicle may move during these test. If the machine starts to move, fully depress the decelerator pedal and shift the drive train control lever to NEUTRAL.

6. Start the engine and operate with drive train control lock lever. Check for leaks and functioning. Shut off the engine.
7. Reinstall cover (1, Fig. 7C.94) and secure with bolts (2).
8. Install filter (4, Fig. 7C.95) to the filter bracket (3) and secure with bolts (2). Reconnect the electrical harness to the filter base.
9. Reinstall L.H. enclosure (3, Fig. 7C.94) on the left hand side and secure with bolts (4).